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DECENTRALIZED PLATFORM FOR FINANCING CHARITY PROJECTS

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Abstract. *The rapid development of new technologies, together with the emergence of new military conflicts and humanitarian crises, creates the need for quick response and the introduction of new methods of effective assistance to the affected population and the restoration of damaged territories. Decentralized charity became one of these methods of assistance. To implement the task, the latest technologies were used, which combine maximum transparency and complete security when forming and working with charitable payments. The main technologies that were used: blockchain and smart contracts on it, protocols of liquidity pools and profitable farming, as well as web development technologies for creating a web application. The research analyzed existing approaches, methods of software solutions for financing decentralized charity; developed and improved the mathematical model and architecture of the software application. A system of smart contracts was created using additional administrative modules, and on its basis, a decentralized charitable platform for assistance to Ukraine was implemented in the form of a web application. Such a decentralized system can be freely used and implemented nowadays to finance the most necessary charitable projects of our country with crypto-assets in various spheres: humanitarian, social or in matters of security and weapons.*

Keywords: charity, decentralization, blockchain, smart contract, decentralized finance, liquidity pool, web platform

ZDECENTRALIZOWANA PLATFORMA FINANSOWANIA PROJEKTÓW CHARYTATYWNYCH

Streszczenie. *Szybki rozwój nowych technologii, wraz z pojawieniem się nowych konfliktów zbrojnych i kryzysów humanitarnych, stwarza potrzebę szybkiej reakcji i wprowadzenia nowych metod skutecznej pomocy dla dotkniętej ludności i odbudowy zniszczonych terytoriów. Zdecentralizowana działalność charytatywna stała się jedną z tych metod pomocy. Do realizacji zadania wykorzystano najnowsze technologie, które łączą w sobie maksymalną przejrzystość i pełne bezpieczeństwo podczas tworzenia i pracy z płatnościami charytatywnymi. Główne technologie, które zostały wykorzystane: blockchain i inteligentne kontrakty na nim, protokoły puli płynności i dochodowego rolnictwa, a także technologie tworzenia aplikacji internetowych. W ramach badań przeanalizowano istniejące podejścia, metody rozwiązań programowych do finansowania zdecentralizowanej działalności charytatywnej; opracowano i ulepszono model matematyczny i architekturę aplikacji. Stworzono system inteligentnych kontraktów z wykorzystaniem dodatkowych modułów administracyjnych, a na jego podstawie wdrożono zdecentralizowaną platformę charytatywną do pomocy Ukrainie w formie aplikacji internetowej. Taki zdecentralizowany system może być swobodnie wykorzystywany i wdrażany obecnie w celu finansowania najbardziej potrzebnych projektów charytatywnych naszego kraju za pomocą kryptoaktywów w różnych sferach: humanitarnej, społecznej, bezpieczeństwa i uzbrojenia. lub w kwestiach bezpieczeństwa i broni.*

Słowa kluczowe: dobroczynność, decentralizacja, blockchain, inteligentny kontrakt, zdecentralizowane finanse, pula płynności, platforma internetowa

Introduction

The rapid development of new technologies, along with the emergence of new military conflicts and humanitarian crises, create the need for a rapid response and implementation of new methods to effectively assist victims and restore affected areas. Decentralized charity has become one of such methods of assistance, especially during the ongoing war in Ukraine. Decentralization of charity opens up opportunities for complete security and transparency when transferring donations in the form of cryptocurrency.

Among the works on cryptocurrencies, it is worth noting the work of D. Tapscott, A. Tapscott [9], which summarizes the knowledge on blockchain technology and makes a forecast concerning its development. G. Heilman, M. Rauckx [4], the authors studied in detail the situation on the cryptocurrency market in general and on cryptocurrency exchanges in particular. In the work of A. Gervais, G. Karame, K. Wüst [3], the researchers examined the effectiveness of the Proof-of-Work (PoF) consensus algorithm, which is used in more than 90% of modern decentralized systems. Modern scientists are actively conducting research in the field of cryptocurrency payment systems. Thus, O. D. Vovchak, G. E. Shpargalo, T. Ya. Andriykiv considered the essence and concepts on the functioning of payment systems, their technological infrastructure and protection measures [8, 12]. The analysis of publications and scientific studies showed the presence of problems associated with existing decentralized payment systems, but in the aspect of applying the decentralized system of charitable contributions with cryptoassets the issue was not directly considered. Therefore, the key task is to create a universal method of charity that would allow the public and organizations to channel funds directly to specific projects and people in need without any intermediaries, in a secure and open manner. Such a method should be safe, accessible and provide control over the expenditure of funds, and should also address the problem of loss in the number of donations.

It should be noted that during the four months of the full-scale war, the average amount of charitable contributions per benefactor was UAH 9,730. This is nine times more than in 2021, when this amount was UAH 1046, according to the study Charity in Times of War by the Zagoriy Foundation. However, the intensity of donations is gradually decreasing. Half of all charitable contributions are received during the first 40 days of a full-scale war, and the other half - in the next three months. According to Forbes, in June 2022, the 20 largest charitable foundations raised UAH 3.1 billion to support Ukraine — the smallest monthly increase since the beginning of the war. It is also 28% less than in May 2022 [6, 7].

Regarding charity provided in crypto assets, it should be noted that the Binance Charity Foundation donated about $10 million to charitable organizations in the first days of the war, and another $500,000 in April 2022. In addition, the cryptocurrency exchange has launched a unique Refugee Card, which allowed refugees to receive transfers and financial assistance in the EU and can now be used as an indispensable payment tool. In addition, as part of the IT Generation project, the Binance Charitable Foundation allocated $1 million for scholarships to retrain 2,000 Ukrainians who lost their jobs during the war, while Everstake donated $10 million to volunteer organizations and became one of the founders of the Aid for Ukraine initiative. The company continues to run charitable projects in various areas, such as Save Ukrainian Culture [1, 14].

Due to their technical features, digital assets have become a significant tool for financial support of humanitarian and military initiatives. They have made it possible to provide targeted payments to refugees who do not have access to foreign banks and to donate worldwide, bypassing the restrictions of countries and regulators. In addition, cryptocurrencies have expanded the funds' capacity to make purchases that would be difficult to make through the banking system. For example, according to the Ministry of Digital Transformation of Ukraine, approximately 60% of military equipment suppliers accept cryptocurrency, so public and private organizations are actively using it.

1. The aim and objectives of the study

The purpose of the paper is to research the means of implementing decentralized charity, to create improved methods, and to introduce them on the web platform.

To achieve the goal of encouraging cryptoasset users to engage in long-term and profitable charity, the latest technologies should be used that combine maximum transparency and complete security in the formation and handling of charitable payments. The main technologies that will be used are: blockchain and smart contracts on it, protocols of liquidity pools and profitable farming, as well as web development technologies to create a web application.

2. Methods

Mathematical analysis of key aspects of blockchain protocols that determine the efficiency and sustainability of decentralized financial systems is an integral part of decentralized philanthropy research. A mathematical approach will allow us to better understand the internal mechanisms of these protocols, identify the main parameters and factors that affect their effectiveness.

3. An analysis of the Uniswap decentralized exchange and its liquidity pools

Uniswap is a completely new type of exchange that is fully decentralized, meaning it is not owned or operated by a single entity, and uses a relatively new type of trading model known as an automated liquidity protocol. Uniswap is also completely open, meaning anyone can copy the code to create their own decentralized exchanges. Even users can deposit tokens on the exchange for free. Conventional centralized exchanges are profit oriented and charge high fees for depositing new coins, so this in itself is a notable difference. Since Uniswap is a decentralized exchange (DEX), it also means that users always retain control of their funds, unlike a centralized exchange that requires users to hand over control of their private keys so that information about exchanges can be entered into the internal database. By maintaining control over private keys, the risk of losing assets in the event of an exchange hack is eliminated. According to recent data, Uniswap is currently the fourth largest decentralized finance (DeFi) platform and has more than $3 billion worth of cryptocurrency assets locked in its protocol [11, 13].

Uniswap is an automated liquidity protocol based on the constant product formula and implemented in a system of non-updateable smart contracts on the Ethereum blockchain. It eliminates the need for reliable intermediaries by prioritizing decentralization, censorship resistance, and security [5].

Each Uniswap smart contract, or pair, manages a liquidity pool created from the reserves of two ERC-20 tokens. ERC-20 is a standard that allows the implementation of a standard API for all tokens within smart contracts. This standard provides basic functionality for transferring tokens and also allows tokens to be approved so that they can be spent by other parties on the blockchain [2].

Anyone can become a Liquidity Provider (LP) for the pool by contributing the equivalent value of both base tokens to the interaction for pool tokens. These tokens track the LP's proportional shares of the total reserves and can be redeemed for the underlying assets at any time.

Cryptocurrency pairs act as automated market makers, ready to accept one token for another, observing the conditions of "constant product" (figure 1).

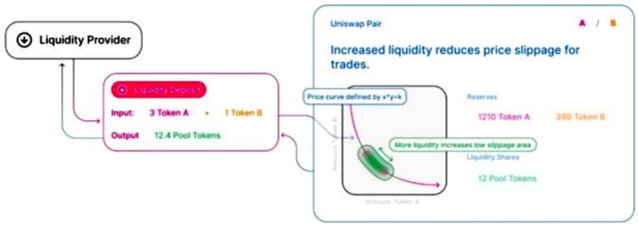

Fig. 1. The principle of operation of a liquidity provider and price changes among a pair of cryptoassets according to the Uniswap protocol documentation

The constant product can be expressed most simply as:

$$x \cdot y = k$$

It states that trades should not change the product k of the reserve balances of the pair x and y. Since k does not change during the trading of a pair of cryptoassets, it is often called a constant value. This formula has the desirable property that larger transactions (relative to the total reserves of cryptoassets in the pair) are executed on exponentially worse terms than smaller ones Fig. 2.

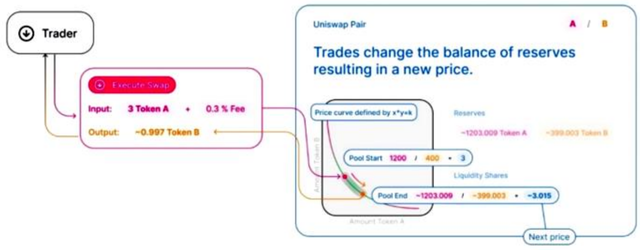

Fig. 2. The principle of changing reserves and prices according to the constant product as defined in the documentation of the Uniswap protocol

In practice, Uniswap applies a commission of 0.30% to trades, which is added to reserves. As a result, each transaction actually increases the value of k. This acts as a payment to Liquidity Providers (LP), which is realized when they destroy their LP Tokens to withdraw their portion of the general reserves. In the future, this fee may be reduced to 0.25%, leaving the remaining 0.05% as a protocol fee.

Since the relative price of the two assets of a pair can only change through trading, deviations between the Uniswap price and external prices create opportunities for arbitrage. This mechanism ensures that Uniswap prices always tilt towards the overall market price.

4. Analysis of the staking process in decentralized finance

Usually, quite simple formulations, methods and tools are used to implement staking [10]. One of these is the generally accepted formula for staking, it is determined that there is a certain function r that forms the reward earned by the user u from k to n seconds:

$$r(u,k,n) = \sum_{i=k}^{n-1} \frac{S_i}{T_i} R \qquad (1)$$

where S_i is the amount placed by user u at time i, T_i is the total balance of tokens delivered at time i (assume $T_i > 0$), R is the reward rate per second (total reward / duration).

This formula is easy to understand and calculate, and can be implemented in any programming language. Unfortunately, this is not the case for the Solidity smart contract programming language, for two reasons:

1. The use of loops in the sum will lead to very high costs for the execution of the program code in Solidity operations on the blockchain.

2. S_i is included in the sum, which in turn makes each element in the sum unique to a specific user at specific time. If we have 100 users and 500 seconds in the contribution event, this will result in 500,000 calculations.

The formula can be improved by assuming that S always remains constant for the time interval from k to *n-1*. This means that $S_i = S_{i+1}$. This often happens in real-world investment events, as most users rarely change their investment amount. And even if they do, we can just treat them as a new nested event, which still results in less computation. Then formula 1 will look like this:

$$r(u,k,n) = S\sum_{i=k}^{n-1}\frac{R}{T_i} \quad (2)$$

Also, the sum over the time interval from k to n-1 is equal to the sum over the time interval from 0 to n-1, minus the sum over the time interval from 0 to k. Thus, function 2 can be further rewritten as follows:

$$SR\left(\sum_{i=0}^{n-1}\frac{1}{T_i} - \sum_{i=0}^{k-1}\frac{1}{T_i}\right) \quad (3)$$

This simple formula represents the latest form of the staking function.

5. Analysis of charitable cryptoassets

Charitable cryptoassets arose from the desire to create their own currency for specific charitable initiatives, such as those related to clean water.

These projects promise to give buyers peace of mind by participating in a currency specifically designed for charitable donations based on a shared public ledger that allows donors to track how their money is being used. However, it is worth noting, they are not proven to be effective on a large or small scale, and are much more experimental than other charitable cryptocurrency initiatives [9].

For donors who want to choose a cause-oriented model, coins such as the Clean Water Coin, which raises funds exclusively for water-related charitable projects, provide a quick and easy way for donors to give crypto support to a chosen charity.

There are also organizations like AidCoin which has taken a comprehensive approach to the crypto ecosystem. It has developed a transparent donation token (AidCoin), a donation platform (AidChain) and a payment gateway as an embeddable widget (AidPay) that allows charities registered on the AidChain platform to accept and convert other currencies into AidCoin.

Another company, Pinkcoin, uses its own philanthropic token that donors can give to charity while being rewarded for their generosity.

Compared to other experiments in the digital currency area, PinkCoin has performed well, yet the overall state of charity in decentralized finance is quite encouraging. It should be noted that this area is not developed at all, and the creation of a new platform using already commonly accepted means of decentralized finance can make users turn their attention and especially their money to this area, which will be more similar to all the familiar methods and means of financing decentralized protocols.

Taking into account the analyzed means and methods in the field of decentralized finance, by combining the methods of several of them, a protocol can be created to deposit electronic funds into liquidity pools on a collateral basis, with further interest income from their use. On the other hand, the blocked funds can be used for charitable purposes or to support the Armed Forces of Ukraine by exchanging the deposited funds for new assets.

It is important to note that attracting new assets will increase their use, which in turn will attract new users to the system, distributing these assets to the decentralized world. In addition, these assets can serve as a gateway to additional opportunities in the system, such as participation in battlefield trophy drawings or participation in voting among users of the charity system.

Also, it is appropriate to create a certain market of unique tokens, which will give users access to additional features of the system or which will be confirmation for receiving rewards after auctions with trophies from the battlefields. Exchanges, purchases and other operations will have a percentage of the fee for their implementation, the funds from which can also go to charitable projects.

6. Improving the model of profitable charity through staking technology

The system will have two main methods of making a profit through charity: liquidity pools and staking. Their main goal is to provide an opportunity to invest philanthropists' funds to solve humanitarian and other problems in Ukraine. Earnings from charity are calculated according to proportional formulas and provided in the form of platform tokens – an additional decentralized currency that has its own capabilities and ways of using it.

While for liquidity pools, we have a proportional dependence on the number of deposited funds and the number of received platform tokens, for staking, the situation is not so clear.

As a starting point, we will take the general staking formula (formula 3), but for the staking technology to work properly, it is necessary to think in advance about the rules for calculating rewards, because as the total number of platform tokens among users increases, their overall profitability increases, which in turn can lead to endless token emission and a decrease in its value relative to other currencies.

For further calculations, choose the initial data. These data will be:

- the current number of all created platform tokens s_{supply}.
- the current number of platform tokens already in the staking protocol s_{staked} .
- the number of tokens available to the user to be added to the protocol x .

Next, you should calculate the percentage ratio of tokens lying in staking to the total number of tokens:

$$P_{staked} = s_{staked} \cdot \frac{100}{s_{supply}} \quad (4)$$

where P_{staked} is the percentage value of the dependence of the number of tokens in the staking protocol on the total number of tokens, s_{staked} – the number of tokens in the staking protocol, s_{supply} is the total number of tokens.

To calculate the ratio of free tokens in circulation to the total number, we will use the following formula:

$$P_{diff} = 100 - P_{staked} \quad (5)$$

where P_{diff} is the percentage of the dependence of the number of free tokens on the total number of tokens, that is, the difference between tokens in staking and tokens in general, P_{staked} is the percentage of the dependence of the number of tokens in the staking protocol on the total number of tokens.

Also, you should calculate the number of tokens remaining in circulation according to the formula:

$$s_{diff} = s_{supply} - s_{staked} \quad (6)$$

where s_{diff} is the number of tokens remaining in circulation, s_{supply} – total number of tokens, s_{staked} is the number of tokens in the staking protocol.

Then, according to formulas 7 and 8, we will find the minimum and maximum permissible value for investment in the staking protocol according to the previously mentioned initial parameters:

$$s_{min} = floor\left(s_{diff}^{\frac{P_{staked}}{100}} \Big/ s_{diff}^{\frac{P_{diff}}{100}}\right) \quad (7)$$

where s_{min} is the minimum value of funds to be contributed to the staking protocol, P_{staked} is the percentage of the number of tokens in the staking protocol to the total number of tokens, s_{diff} – the number of tokens remaining in circulation,

P_{diff} – the percentage of dependence of the number of free tokens on the total number of tokens, i.e. the difference between the tokens in staking and the total tokens, $floor(x)$ – a function that rounds and returns the largest integer that is less than or equal to the specified number *x*.

$$s_{max} = floor\left(s_{diff}^{\frac{P_{staked}}{100}}\right) \quad (8)$$

where s_{max} is the maximum value of funds to be entered into the staking protocol, P_{staked} – the percentage of the number of tokens in the staking protocol to the total number of tokens, s_{diff} is the number of tokens remaining in circulation.

The graph of the above formulas Fig. 3 demonstrates the dependence of the user's initial capital on the total number of tokens in circulation and the number of tokens in the staking protocol and their impact on changing the minimum and maximum values of the allowable contribution to the protocol.

The graph shows the value of the number of tokens available to the user in black, for example, 4000 tokens. Then, according to the graph, the minimum and maximum token contribution that a user can make is 144 and 761 tokens, respectively. Also, the black dotted line indicates the limit of the minimum and maximum contribution values, it is limited in this way, because the contribution value cannot in any way exceed the value of free tokens in circulation. Also, it should be noted that rounding functions were used for calculations, since tokens do not have a fractional part.

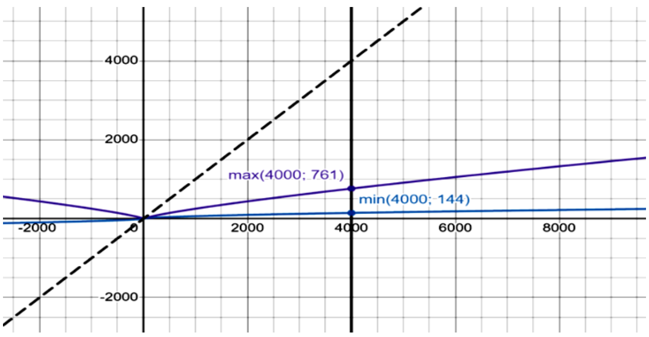

Fig. 3. Graph of the dependence of the number of tokens on the minimum and maximum contribution to the staking protocol

The main feature of staking is the proportional dependence of the time the blocked capital stays in the protocol to the final reward. This is also an important aspect of this technology that requires a clear calculation.

First of all, it should be noted that for our system, the best scenario would be if users hold the tokens of the platform as long as possible, thereby increasing their income and the number of blocked tokens in the protocol. In order to make it profitable for users to hold tokens for a long period of time, a proportional increase in reward should be provided in relation to the time elapsed for the blocked assets.

The following ratios were chosen to obtain a function of the elapsed time to the remuneration modifier coefficient: 1⁄1, 6⁄1.3, and 12⁄2. For example, if a user holds assets for more than 6 specific time periods (day, month, year), his reward will increase by 1.3 times, if the user holds assets for up to 12 time periods, the reward will increase by 2 times. Using any of the Lagrange or Newton interpolation polynomial methods, we find an approximate equation according to these points. The result will be the following parabola equation:

$$y = 0.005x^2 + 0.024x + 1 \quad (9)$$

where y is the value of the reward modifier, x – the value of the number of elapsed time intervals.

The value of the number of elapsed time intervals is calculated very easily:

$$t = floor(e_{time} - s_{time}) \quad (10)$$

where t is the value of the number of elapsed time intervals, e_{time} is the value of the current time interval, s_{time} is the value of the initial moment of time.

Then, for example, if 2 time intervals have passed, the coefficient will be equal to 1.07, and if 7 time intervals have passed, the coefficient will be equal to 1.42. Figure 4 shows the results of the calculations.

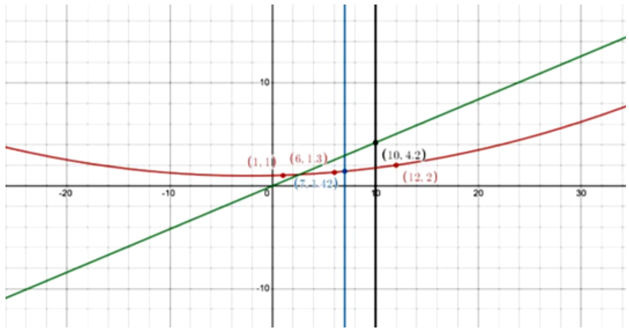

Fig. 4. Graph of dependencies from elapsed time intervals to the final reward to the user

First, you should pay attention to the red graph and its red points, these are the same points that were indicated at the beginning, and the graph is the solution to equation 9. The blue color indicates the value of the elapsed time intervals, and at the intersection with the red graph is the point whose value in the y-coordinate is the value of the coefficient. The graph of the number of funds to which the resulting coefficient is applied is shown in black. The green graph shows the dependence on the amount of deposited funds on the net profit according to the obtained coefficient. The calculation of this graph is determined by the following formula:

$$y_{rew} = x \cdot y_{time} - x \quad (11)$$

where y_{rew} is the value of net profit, x – the value of funds deposited into the staking protocol, y_{time} – time is the resulting elapsed time modifier.

The point of intersection of the black and green graphs is the user's profit point, and the value on the y-coordinate is this value.

Also, the logic of encouraging users to staking was implemented by increasing the reward coefficient relative to the number of already blocked tokens in the protocol. This reward modifier is calculated as follows:

$$y_{rew} = x \cdot \frac{s_{mul}}{100} \quad (12)$$

where y_{rew} is the value of net profit, x – the value of funds deposited into the staking protocol, s_{mul} is the percentage of the relationship between the amount of user funds and the number of tokens blocked in the staking protocol.

The percentage value of the ratio of the amount of user funds to the number of tokens blocked in the staking protocol is calculated as follows:

$$s_{mul} = x \cdot \frac{100}{s_{staked}} \quad (13)$$

where s_{mul} is the percentage value of the relationship between the amount of user funds and the number of tokens blocked in the staking protocol, x – the value of funds deposited into the staking protocol, s_{staked} is the number of tokens in the staking protocol.

According to formulas (11)–(13), the final equation for calculating the net reward depending on the elapsed time and the total number of tokens in circulation and blocked in the protocol can be written:

$$y_{rew} = (x \cdot y_{time} - x) + \left(\frac{x^2}{s_{staked}}\right) \quad (14)$$

where y_{rew} is the value of net profit, x is the value of funds deposited into the staking protocol, y_{time} is the elapsed time modifier, s_{staked} is the number of tokens in the staking protocol.

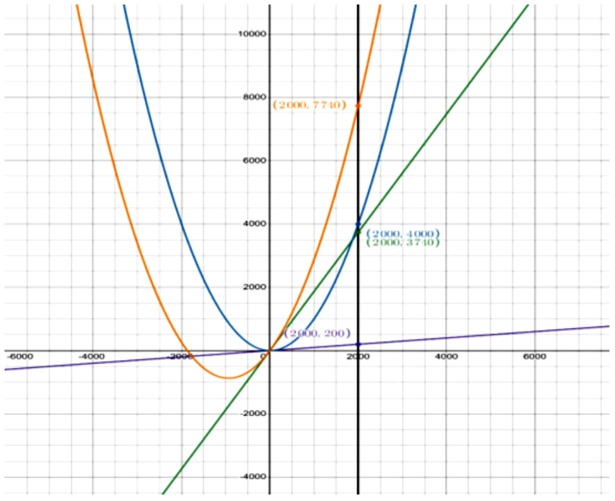

Fig. 5. Graph of dependence of net profit on initial user funds and modifiers of elapsed time and blocked assets

The final equations can be used to create a set of function graphs Fig. 5.

As usual, the graph of the initial amount of user funds was marked in black. The graph and the intersection point of the equation s_{mul} , the percentage value of the dependence of the amount of user funds on the number of tokens blocked in the staking protocol, are marked in purple. The graph and the intersection point of the relationship between the amount of deposited funds and the net profit according to the elapsed time modifier are marked in green. The influence and ratio of the number of blocked funds in the protocol to the user's available funds is shown on the graph and the intersection point in blue. The total ratio of the number of user tokens to the net profit according to the available initial data is shown in the orange graph and the intersection point with the graph of the value of the user's funds.

The decentralized charity platform is designed for several categories of users: philanthropists, charitable organizations, and administrators. The created platform is flexible in terms of expansion and management and can be used as a part of or the basis for larger-scale software solutions in the field of decentralized charity.

To implement the planned functionality, a smart contract system was developed that describes in detail the data required for storage, methods and means of interacting with them Fig. 6, [6]. The diagram identifies five groups of modules according to their purpose and functions, and describes the contract status fields, their types, and the links between them.

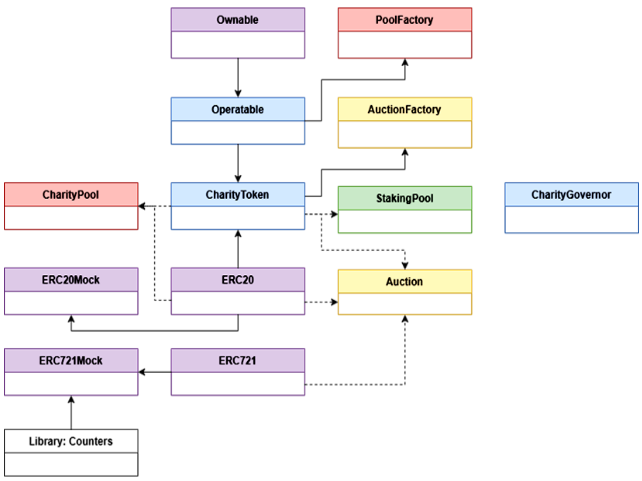

Fig. 6. Architecture of the smart contract system

The main modules based on the implemented Ethereum blockchain standards are marked in purple. Among them are ERC721 and ERC20 standards for irreplaceable and replaceable tokens, respectively. To test the system, we created the ERC20Mock and ERC721Mock auxiliary contracts. The Ownable contract serves to use the functionality according to the contract creator.

The next group of contracts is in blue. This is a group of auxiliary contracts, for example, the Operatable contract is used as a module for granting rights to use certain methods to other contracts, and the CharityGovernor contract is a contract for voting and implementing ideas to improve the charity platform. The CharityToken contract, on the other hand, is the main token of the platform, and as mentioned in the previous sections, is used as a currency for various functionalities on the platform.

Under the yellow color are the modules of the auctions and the irreplaceable token market on the platform. They implement all the logic related to the transfer, exchange, purchase and sale of these tokens.

The staking protocol contract is marked in green. It was singled out because it contains complex logic, also because this contract can exist completely autonomously without additional intervention from the administrator.

The last group of contracts is marked in red. This group is responsible for liquidity pools and everything related to them. Also, these modules ensure the creation of new charity projects and charities themselves on the platform.

Smart contract technology and the Solidity programming language, the most popular among EVM-type blockchains, were used to write the software web application. The Hardhat framework was chosen as the technology for designing and developing the backend. Instead, web application development was done using technologies such as Typescript, NextJS, HTML, and CSS. During the creation of the platform, Git technology was used to track development and code changes between different versions of the application. With this technology, the software code is open and stored in the remote cloud environment GitHub. Visual Studio Code.SS was used as the development environment.

The developed platform was designed in detail and described by mathematical models. The functionality of the created charitable platform is designed for three main categories of users: charitable organizations, benefactors, and administrators. Each of them has its own interface for interacting with the platform and smart contracts. A charitable organization can create new charitable projects, which, in turn, will be financed by benefactors, and benefactors, in turn, will receive rewards for their contributions, which they will later be able to use in the staking protocol or in the irreplaceable token market by participating in various auctions. The administrator has additional options for managing the charity platform, namely, creating new charities and adjusting interest rates for various system functionalities.

In addition, a web application was developed to demonstrate the operation of the system. In it, users are given the opportunity to view the data that exists in the system base, and also learn about the life of the platform.

7. Conclusions

1. As a result of the development of the decentralized charitable system, a transparent and secure platform was created that provides an opportunity for free donations and has the following functionalities:

- Liquidity pools, as charitable projects created by organizations, contributions to which provide proportional income in the form of new platform tokens.

- Staking protocol as a way of passive earnings on charity. It provides an opportunity to introduce funds from benefactors to solve humanitarian and other problems of Ukraine.
- Auctions of irreplaceable tokens and their market.

This made it possible to expand and improve decentralized financing methods for use in charity.

2. The mathematical model and architecture of the software application have been improved.

3. A system of smart contracts has been created using additional administrative modules for their management and updating. Based on the system of implemented smart contracts, a decentralized charitable platform in the form of a web application has been implemented.

4. The platform is implemented through two structural elements: the server part and the web application. The server part is a set of smart contracts that describe the main business processes of the platform. Instead, the web application serves as a cover for the server part and has a clear interface to all system functions.

The developed platform is flexible in terms of expansion and management and can be used as a part or basis for larger software solutions in the field of decentralized charity.

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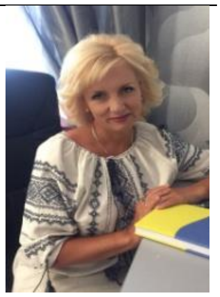

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