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Secure Framework for Government Tender Allocation Using Block Chain

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ABSTRACT: Governments and public sector organizations throughout the world are actively looking for innovative ways to keep up with technological advancements in order to achieve smart governance, increase work efficiency, and cut costs. Blockchain technology is one such innovation that has recently attracted the attention of governments all around the world. Because of its increased security, enhanced traceability, and least expensive infrastructure, the blockchain can be used in a variety of fields. Many third-party companies frequently receive tenders from governments for certain projects. Furthermore, the dishonest government representatives seek a sizable bribe in exchange for passing the offer in favor of a particular third party. We presented a blockchain-based system for secure and transparent government bids in this post. Because they are so vulnerable to attack, government papers are stored on blockchain as a secure and immutable data format. This endeavor aims to provide an edge computing infrastructure that is transparent and secure for the work- flow in government tenders to carry out government programs and policies while minimizing human supervision.

I. INTRODUCTION

Blockchain technology is a very promising alternative to improve the degree of security, privacy, openness, and productivity across the government bidding process. With the help of blockchain technology, all parties interested in an offer might join the same network and be able to closely monitor the work-flow. Governments in a number of nations, including Georgia, the UK, the UAE, Australia, China, Japan, and Russia, are making quick progress toward integrating blockchain technology into their daily operations. Governments in several developing countries, such as India, have backed various initiatives and rules for the implementation of blockchain technology in recent years. Many projects have been made to leverage technology to speed up and eliminate paper in government processes, such as online tax filing, online tendering, and online ticketing. In most administrations, complicated bureaucratic processes typically result in a very inefficient work flow that is riddled with corruption, subpar management, and human mistakes. One procedure where errors like information leaks, corruption, and bribery are evident is the process of awarding government contracts. The aforementioned limitations apply to the majority of electronic services and IT infrastructure now in use, however new technologies like blockchain have the potential to greatly address these problems. In order to successfully implement national policy for the benefit of its population, a permissioned blockchain network can provide the necessary transparency. It can also establish responsibility in the case that the system is misused.

II. RELATED WORK

Only a few studies particularly address blockchain applications in the government sector, which is a sad state of affairs. This shows that applications relevant to the government and the other important disciplines of study have used Blockchain technology differently. The use of blockchain in public procurement is thus a growingly popular subject. The use of blockchain in numerous application cases and industries is covered by Joe Abou et al. in node. The authors of have outlined the benefits and opportunities of using blockchain technology to save the time and labor required to administer and maintain government projects. Smart contracts are proposed as a potential solution to eliminate bribery and corruption in the operation of government offices. They also drastically reduce the time required to complete tasks, launch new services, and enhance the public's quality of service (QoS). Blockchain could

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be used to increase public-government communication transparency, according to Svein et al. The data can be made anonymous, and the transaction can be reviewed and tracked, both of which will increase overall fairness. The authors of contend that utilizing the immutability of blockchain technology and storing financial data there will improve the overall standard of the credit system. The authors of advocate the Chinese wall strategy as a means to lessen fraud in government tendering. The contractor will be

awarded a government tender in accordance with the procedure proposed by Hiroshi Fukui et al based on a number of variables, such as price, quality, completion time, etc.

III. PROPOSED MODEL

A. Smart Contract Design:

Smart Contracts are contracts that are written using standardized code and operational requirements and that can be legally enforced. A smart contract is set up to ensure that the transaction won't be added to the block until all nodes correctly inspect and signal it as complete. Once a transaction has been confirmed, the parties' public keys, a timestamp, and the transaction details will all be present in the final transaction log and on the blockchain. As a result of the execution of smart contracts, a set of key-value pairs is produced, which is recorded on the ledger and stored on the blockchain.

B. Decentralize Document Storage:

Most transactions often comprise multiple types of documents that need to be processed, a 3-layer file encryption approach enables an effective and secure decentralized storage for all the essential documents in a given transaction. Additionally, the storage service's decentralized architecture shields users from single points of failure while ensuring quick network access to updated copies.

- Step 1: A Department official will first digitally sign the proposal.
- Step 2: Following the proposal's signature, it will undergo a stage of symmetric encryption (AES-256) by having a random 32-byte passphrase generated for it.
- Step 3: Using asymmetric encryption and the specified person's public key from Dept. B, this passphrase is then encrypted (RSA-512).
- Step 4: The Document is then synced between all nodes and added to the decentralized storage, where it waits to be approved by the other nodes by consensus and confirmed by the smart contract.
- Step 5: After being accepted and confirmed for usage,the proposal will be changed and saved.

C .Consensus Algorithm:

We consider a network model with many builders, loans from the government, and bids. Government lenders submit the tender in which they are interested, outlining the estimated duration, cost, and term of maintenance once the contract is completed. Companies that provide construction services submit bids for the contract, detailing the price, schedule, and maintenance period they can provide. Using consensus, the nodes can reach an agreement. After a transaction has been added to a block, it cannot be modified at a later time. That needs to be verified first.changed and saved. Finally, we compute normalised time, cost, maintenance term, and vote for each function Object() [native code] in order to compare them to the equivalent parameters established by the lender. We start by defining the normalized parameters.

In this case, the normalized values for time, cost, job quality, maintenance duration, and votes are denoted by the letters ND, NP, NQ, NS, and NV, respectively. The maximum and minimum time constraints that the government lenders and the contractors may enter for a tender are denoted by the letters a and b, respectively.
The letters c through j indicate the highest and lowest values of cost, job quality, maintenance term, and tender votes.. Any normalized value can be determined for any tender, function Object() ([native code]), or government lender using Equations 1, 2, 3, 4, and 5.respectively

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Remember that the terms min(D) and max(D) in the aforementioned Eqn. 6 denote, respectively, the min(Dzx) and max(Dzx) among all constructors. The xth function Object() [native code] can use Eqns. 2, 3, 4, and 5 to calculate the normalized cost (NPzx), quality of the task (NQzx), maintenance period (NSzx), and vote (NVzx), respectively, for the zth tender. The normalized time NDzy, cost NPzy, quality of work NQzy, maintenance period NSzy, and vote NVzy for the zth tender by the yth lender, respectively, can be calculated using Equations 1, 2, 3, 4, and 5. It's also possible that the lender's requirements are too stringent, in which case none of the constructors would be able to fairly accept the tender. We offer a two-stage auction approach in which the expectations of the government lender are adjusted if they stray too far from the average expectation of all the builders. We discuss the operation of this double auctioning in the section that follows.

C. OPTIMAL PRICE FORMULATION:

Suppose that the tender Tz is being presented by the government lender Ly. The predicted time NDzy, cost NPzy, level of work quality NQzy, maintenance period NSzy, and level of support NVzy are all given by the government lender Ly in that sequence. The overall cost of the government lender Ly for the tender Tz, including time, cost, job quality, duration of maintenance, and votes, is communicated to all of the contractors C. The group of contractors C who are considering participating in the tender Tz will reveal their total cost in terms of time duration NDzx, cost NPzx, work quality NQzx, maintenance period NSzx, and support NVzx, in that order. It is important that the time period NDzy, cost NPzy, and maintenance period NSzy

Algorithm 1 Cost Optimization among Government Lenders

Input: The expected ND_{zy}, NP_{zy}, and NS_{zy} for the tender T_z given by L_y.

Output: The expected ND_{zy}, NP_{zy}, and NS_{zy} given by government lender L_y brought in the range of ND_{zx}, NP_{zx}, and NS_{zx} values given by ζ_C for the tender T_z.

The median position μ after sorting the values given by set of constructors ζ_C:

$$\mu = \frac{x+1}{2}$$

for $z = 1 : z$ **do**
  repeat
    $ND_{zy} = ND_{zy} + \nu$
  until $(|ND^{\mu}_{zx} - ND_{zy}| \geq \tau)$
  repeat
    $NP_{zy} = NP_{zy} + \nu$
  until $(|NP^{\mu}_{zx} - NP_{zy}| \geq \tau)$
  repeat
    $NS_{zy} = NS_{zy} - \nu$
  until $(|NS^{\mu}_{zx} - NS_{zy}| \geq \tau)$
end for

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Algorithm 2 Cost Optimization among Constructors

Input: The ND_{zx}, NP_{zx}, and NS_{zx} values given by set of constructors ζ_C bidding for the tender T_z.
Output: Final win counts ω_{zx} of constructors bidding for T_z after they reach stopping criteria.
$\omega_{zx} = \{\omega_{z1}, \omega_{z2}, .., \omega_{zx}\}$

Initialize $\xi = 1$
for $z = 1 : z$ **do**
  while $|\rho_{zx,b} - \rho_{zx,b-1}| > \Theta$ **do**
    $\xi = \xi + 1$
    for $x = 1 : x$ **do**
      $ND_{zx} = \frac{D_{zx} - min(D)}{max(D) - min(D)}(b - a) + a$
      $NP_{zx} = \frac{P_{zx} - min(P)}{max(P) - min(P)}(d - c) + c$
      $NQ_{zx} = \frac{Q_{zx} - min(Q)}{max(Q) - min(Q)}(f - e) + e$
      $NS_{zx} = \frac{S_{zx} - min(S)}{max(S) - min(S)}(h - g) + g$
      $NV_{zx} = \frac{V_{zx} - min(V)}{max(V) - min(V)}(j - i) + i$
      $\rho_{zx} = [(w_{dzy} * ND_{zx}) + (w_{pzy} * NP_{zx}) + (w_{qzy} * NQ_{zx}) + (w_{szy} * NS_{zx}) + (w_{vzy} * NV_{zx})]$
    end for
    if $\rho^x_{zx=1} = min(\rho)$ **then**
      $\omega_{zx} = \omega_{zx} + 1$
    end if
    for $x = 1 : x$ **do**
      if $ND^x_{zx=1} \neq min(ND_{zx}), ND^x_{zx=1} \geq \tau_1$ **then**
        $ND^x_{zx=1} = ND^x_{zx=1} - \nu_1$
      end if
      if $NP^x_{zx=1} \neq min(NP_{zx}), NP^x_{zx=1} \geq \tau_2$ **then**
        $NP^x_{zx=1} = NP^x_{zx=1} - \nu_2$
      end if
      if $NS^x_{zx=1} \neq min(NS_{zx}), NS^x_{zx=1} \leq \tau_3$ **then**
        $NS^x_{zx=1} = NS^x_{zx=1} + \nu_3$
      end if
    end for
  end while
end for

Algorithm 3 Allocation of Tenders to Constructors

Input: Final win count ω of set of constructors ζ_C participating in bidding for tender T_z
$\omega_{zx} = \{\omega_{z1}, \omega_{z2}, ..., \omega_{zx}\}$
Output: Tender T_z is allocated to the contructor C_x
$T_z \iff C_x$
for $z = 1 : z$ **do**
  if Only one constructor has maximum win count: **then**
    for $x = 1 : x$ **do**
      if $\omega^x_{zx=1} = max(\omega)$ **then**
        $\mathbf{x} = x$
        $T_z \iff C_{\mathbf{x}}$
      end if
    end for
  else
    for $x = 1 : x$ **do**
      if $\varphi^x_{zx=1} = min(\varphi)$ **then**
        $\mathbf{x} = x$
        $T_z \iff C_{\mathbf{x}}$
      end if
    end for
  end if
end for

Where $\mathbf{x} = x \in \varphi^x_{zx=1} = min(\varphi)$.

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IV. SIMULATION RESULTS

The smart contract is programmed in the solidity language. The results of the smart contract are displayed following implementation on the Rinkeby test network of the Ethereum blockchain platform. In order to demonstrate the efficacy and performance of the suggested model for the government bidding platform, we considered four different government bids. Suppose that Tender1 (T1), Tender2 (T2), Tender3 (T3), and Tender4 (T4) are the four bids and that they are all executing on the same smart contract. According to the government lender Ly, the completion dates for the four tenders— T1, T2, T3, and T4—are 1 year, 1:5 years, 3 years, and 3:4 years, respectively.
According to the government lender Ly, the estimated cost values NPzy for the bids T1, T2, T3, and T4 are 4 million, 10 million, 50 million, and 60 million dollars, respectively. According to the government lender Ly, the anticipated maintenance intervals for the tenders T1, T2, T3, and T4 are 1 year and 6 months, 1 year and 9 months, 2 years, and 4 years respectively.

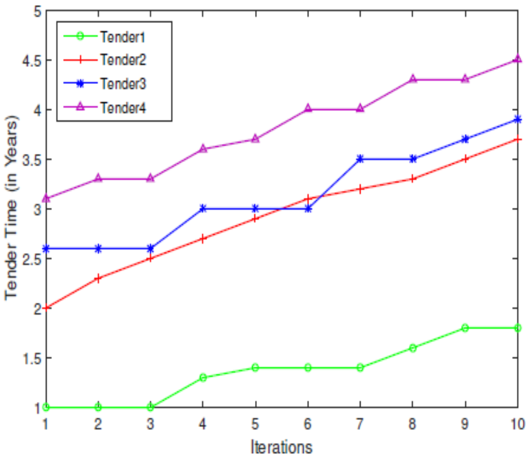

Fig.2: Change of Time Period given by Government Lenders over Iterations

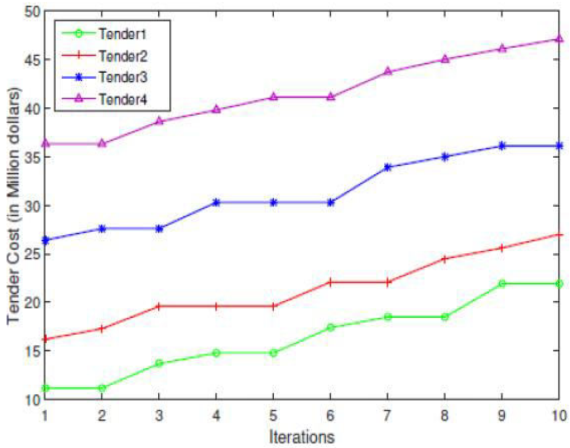

Fig. 3: Change of Cost Value given by Government Lenders over Iterations

V. CONCLUSION AND FUTURE WORK

In this paper, we have covered both the benefits and the requirement of using blockchain technology in the government tender assignment process. Ethereum has been used to create the complete edge computing infrastructure for the government tender work-flow. It is recommended that the best contractors be matched with the tender projects utilizing an iterative auction procedure to increase the profit of government loans and construction firms. We also examined the performance of the suggested model. The suggested model routinely surpasses its competitors in terms of several delicate parameters.

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