

Procurement System Using Blockchain

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ABSTRACT

The Government faces several challenges while publishing tenders on various public projects taking into consideration the scale, diversity, and complexity involved in this entire process. The existing process is long and tedious as there is a lot of manual documentation involved, so maintaining and keeping track of every tender and applicant is difficult.

Blockchain is capable of addressing many such issues and can be used in improving traditional government practices. In this project, we have used Hyperledger Fabric, which is a reliable open-source framework of Blockchain technology. Like other blockchain technologies, Hyperledger Fabric has a ledger, uses smart contracts, and is a system by which participants manage their transactions. In our project, we have implemented a Blockchain network that would help us to keep track of tenders.

Using Blockchain technology provides more security by providing a shared ledger and helps us keep track of every minute detail of a tender. Although keeping all the information related to applicants, tender details, and user profiles is not feasible, we had to implement a secondary database using MongoDB to maintain all the non-critical insensitive information in the secondary database on a different server. Using a secondary database allows storing non-critical tender details and insensitive data of users and prevents storage overhead on the blockchain. The front-end part of the website is built using the ReactJS library where the government authorities can publish new tenders and on the other hand, applicants can create their profiles and apply for those tenders.

Keywords— *Blockchain, Hyperledger Fabric, MongoDB, ReactJS, Database*

I. INTRODUCTION

The Government is setting its foot into the domain of privatizing the public sector. This will help the government focus more on administration and increase their efficiency. The competition between private companies to secure projects from the government and providing the best facility will also in turn increase the quality of infrastructure and vastly improve the quality of facilities provided by the Government. Businesses identify public procurement in India as especially vulnerable to corruption (ICS 2016). Companies report that public funds are at times diverted to companies, individuals, or groups as a result of corruption, and that favoritism influences the decisions of government officials (GCR 2016-2017). In exchange for government contracts and permits, bribes and illegal payments are often traded (GCR 2016-2017). Four out of ten businesses surveyed plan to offer

gifts in exchange for a government contract (ES 2014).

We built a secure procurement system using Blockchain technology to eliminate these frauds. Blockchain has the ability to reimagine existing systems, allowing for new sources of productivity and value to emerge. In its most basic form, a blockchain is a time-stamped collection of immutable data records maintained by a group of computers that are not operated by a single individual. Cryptographic concepts are used to protect and connect each of these data blocks (blocks) (chain). The blockchain network has no centralized power, making it the epitome of a democratic structure. The knowledge in it is available to everyone and everybody because it is a shared and permanent ledger. As a result, everything built on the blockchain is transparent by definition, and anyone involved is responsible for their actions. The data on a blockchain is stored in a shared — and constantly reconciled — database. This is a method

of using the network that has a lot of advantages. Since the blockchain database isn't located in a centralized location, the data it stores is genuinely accessible and easily verifiable. There is no centralized version of this data that a hacker might access. Its data is open to everyone on the internet and is hosted by millions of computers at the same time.

II. PREVIOUS WORK AND LITERATURE SURVEY

A. Supporting Private Data on Hyperledger Fabric with Secure Multiparty Computation

In this project, they used blockchain to create user access controls for different users, as every user doesn't have the authority to view all the information. So, there are various methods in blockchain to make this work, there are some compromises that are to be made. So, these authors have devised a new method to solve this problem. They would insert the data in the ledger in encrypted format and if a particular user wants to access the data, he/she must have the key to decrypt the data. That's how the access control is maintained efficiently. And for this encryption method they have designed Multiparty Computation (MPC) protocols, which are written in the smart contracts [1].

B. Exploring Blockchain Technology for Capital Markets: A Case of Angel Fund

In this project, they are trying to close the gap between the investors and the startups who have their ideas and need funding for their projects. So, they are maintaining a track of funds by using a blockchain, accordingly they have designed their smart contracts as security is necessary in such peer-to-peer business [2].

C. Blockchain: The India Strategy

This discussion paper, which is the first part of the strategy titled "Blockchain: The India Strategy –Towards enabling Ease of Business, Ease of Living, and Ease of Governance," aims to address the best use cases for blockchain technology that can solve problems without raising costs. The paper begins by examining the role of blockchain in promoting confidence in government and private sector interactions, before moving on to considerations when assessing a blockchain use case for implementation, potential obstacles, and lessons learned from NITI Aayog's blockchain implementation experiences. [3].

III. DESIGN AND IMPLEMENTATION

A. Overview of our Procurement System using Blockchain

We propose a web-based procurement system that is running on the blockchain system which is responsible for handling the sensitive information like user's digital signature and tender data and we have a MongoDB database that handles the additional user related details.

The registered user should login as a bidding company or as government in order to do any kind of activity on the web portal. A guest user can not only view the ongoing and closed tenders along with its details but also search for company profiles. If the user is logged in as a bidder, then the user has the ability to apply for any bid which is open at that moment. A bidder also has the permission to change its company details except for a few like Organization Id which is assigned by blockchain. If the user is logged in as government, then the user can publish a new tender which would appear on the home page. A government user has the permission to update any details about tenders and can also declare the winner bidder for that tender after it gets closed.

When the tender is created by the government authority it shows up on the home page of the web portal and the bidders can apply for those tenders. The tender is created and stored onto the blockchain along with some important details like date, time and the creator. When a new user is created, it's digital signature is stored on the server thus ensuring the authenticity of the user. The other user details like contact details, organization name, etc. are stored on the MongoDB database as this is public information. When the tender passes closing date, the government can declare one of the bidders as winner.

B. Implementaion of the Procurement system

1. Project Set-up: As a part of the project set-up, we used Docker software to clone the Hyperledger Fabric images onto our local system. The Hyperledger fabric uses CouchDB which is an open-source NoSQL document database, smart contracts and chain code which can only be written in programming languages like GO, JavaScript and TypeScript. The reason behind choosing GO language in our project is that the Hyperledger Fabric framework is itself written in GO language and is more compatible with it. To interact with the shared immutable ledger of blockchain we need JavaScript scripts which help us in invoking various chain code commands, for example retrieving data from the ledger. The blockchain holds all the sensitive information about our users and tenders. The other non-sensitive user related details are stored on a secondary MongoDB database, which contains details like company description,

establishment date, contact details, etc. We used ReactJS library to build the frontend, ExpressJs for backend and MongoDB to store all the relevant information about users and tenders.

2. Creating the Blockchain Network: We started with designing our own

3. network in the Hyperledger fabric where we needed to specify the number of peers, organizations and channels present in the blockchain network. Then the network is started in the form of docker containers and checked if the network was created properly or not. Then we start writing the chain code for our system, which will store the format of our tender and also the credentials of the users. Then chain code also contains the code to interact with ledger. This chain code is installed on each and every peer of every organization and if the installation is successful then we can invoke different queries to ledger and also add new tenders to ledger.

4. REST API Design: We designed the schema for users and the applied bids stored in the MongoDB database. We further connect this database to the blockchain using REST API. Once the connection is done, we create routes for connecting blockchain with server-side validation. We use local passport strategies to authenticate the user so that only authorized users will be allowed to perform blockchain operations.

5. Frontend: We started off by designing the layout of our website followed by wireframing. We further used ReactJS and Bootstrap4 to convert these layouts into React Components. The website broadly is categorized into two dashboards one for government users and the other one for bidders. Depending upon the role of the user logged in there will be the option to create or apply tender, update their profile and also be able to view profiles of other organizations.

C. Block Diagrams of Our System

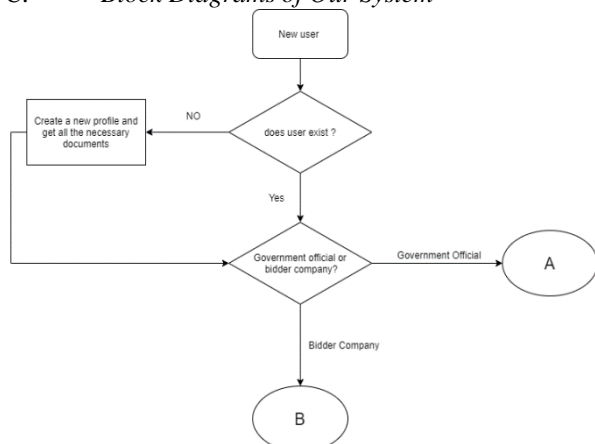


Fig 1. Initial process for new user.

Every time a user logs into the system, we check if that exists. If the user is newly registered then the user is supposed to fill the personal profile to proceed ahead. Depending on the user role as mentioned in the profile, the user will either get directed to a government view or a bidder view. Both these views have a different set of permitted operations and privileges.

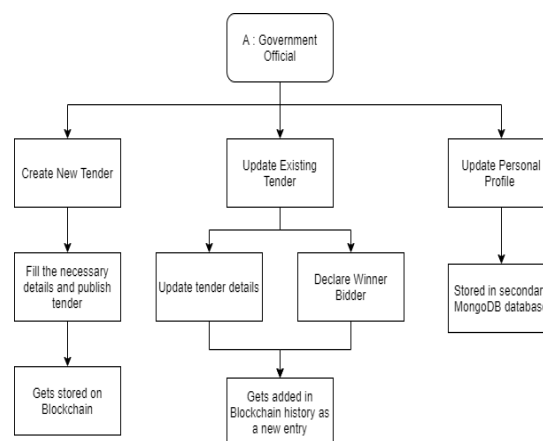


Fig 2. If user is Government Official

If the user is a government official, then there will be three operations allowed which are creating a tender, updating an existing tender, and updating the personal profile. Any changes made to tender will be saved on blockchain and the updates made to user profile will be saved on MongoDB secondary database.

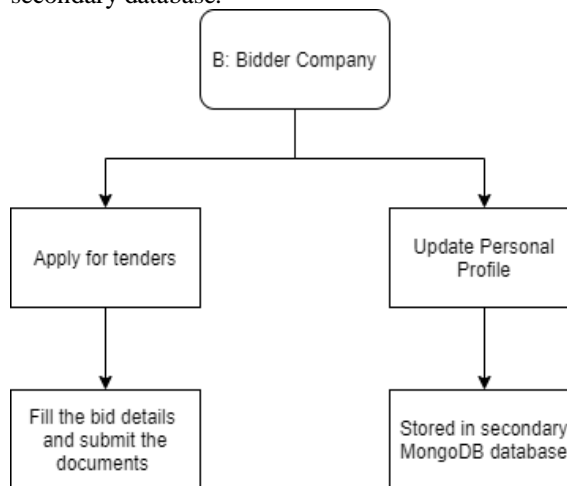


Fig 3. If user is Bidder Company

If the user is a Bidder Company, then there will be only two operations allowed which are applying to a tender and updating the personal profile. Unlike government official users, for bidders, all the bid and user details will be stored on MongoDB secondary database. However, the details of the winning bidder will get saved on the blockchain.

IV. RESULTS AND DISCUSSION

After the completion of the project, we were able to achieve the following web portal view where you are a guest viewer you can see all the latest bids available on the website.

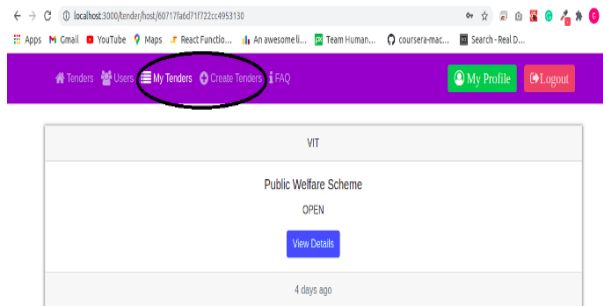


Fig 4. Government View of Web Portal

Fig 4. shows us the UI of government official as the web portal has two extra tabs of 'My Tenders' and 'Create Tenders'. My Tenders tabs will take you to your already published tenders where you can choose to update, close or declare the winner of the tender. Create tender will take you to a form like interface where the government official can create and publish a new tender. Clicking on "View Details" button will take you to the tender details page. And my profile takes you to your profile page where you will find all the details given to our web portal during the creation of your account.

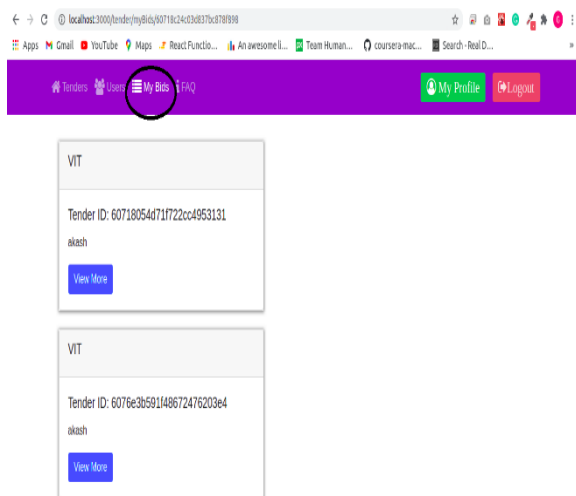


Fig 5. Bidder Company View of Web Portal

Fig E. shows us the UI of bidder company as the web portal has the tab of 'My Bids' and all the tenders to which the user has applied to, shown on the screen. My bids tab shows you the current view in the image, about which tenders has the company applied to. My Profile will be having all the company related details.

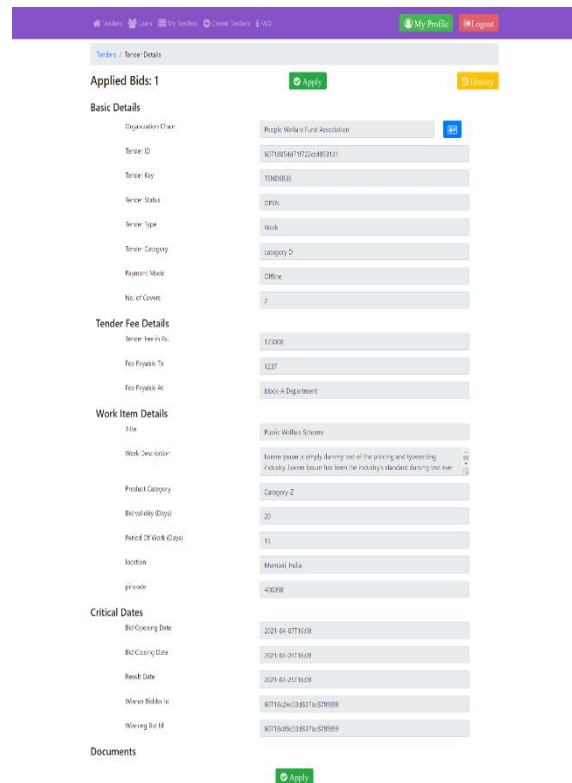


Fig. 6. View of Tender

Fig. 6. shows us the view of tender. If user is a bidder, then you will get the option to apply for the tender. If user is a government official, then user can fill all these details and publish the tender. Or if the tender is published, then user gets the option to update the tender details or declare a winner bidder from all the bids applied.

#	Key	Value
1	tender	0038880019014537185045000304a4b0c0811440000457083115
2	tenderId	710F033
3	id	00718054471722cc4953131
4	state	OPEN
5	bidCount	1
6	bid	007176487101324953131
7	orgName	Nasser Welfare Trust Association
8	tenderType	Work
9	tenderCategory	Category D
10	payMethod	Other
11	mcovers	2
12	tenderNo	12300
13	filePath	123
14	filePath	123456789
15	title	Public Welfare Scheme
16	tenderDescription	Construction of a new building for the printing and publishing industry, covering the entire construction of the building and the interior.
17	publicCategory	Category D
18	bidability	30
19	publicWork	13
20	location	Mumbai, India
21	prcode	43000
22	bidExpiryDate	2021-04-07 18:30
23	bidClosingDate	2021-04-07 18:30
24	issueDate	2021-04-07 18:30
25	publicDate	2021-04-07 18:30 1234567
26	winningBid	00718054471722cc4953131
27	winningBidder	00718054471722cc4953131

Fig 7. History of Tender

Fig. 7. shows us the history of a particular tender from the time it was published. If any changes are made by government official, then the changes and the date and time appear in this tab which can be seen by anyone. This creates transparency among the companies and government as every change appears in this tab. At top shows us the tender ID and below that it shows the time and date of when the tender was changed.

V. CONCLUSION

This paper represents a functional model of procurement system using a Blockchain technology. We have tried to explain how we used Hyperledger Fabric framework to create a private blockchain network to keep a track of the entire procurement process. We have also made a responsive web portal which allows the Government officials to publish tenders and also lets the companies interested in those tenders to apply to them. The web portal is designed in such a way that it provides two different interfaces to interact for the government officials and the bidders based on the role assigned to them. The advantage of using Blockchain is that it helps us track each and every change performed on ledger and also stores data in an immutable manner. The companies interested in being part of this system are supposed to create a profile by providing all the necessary details and the system ensures that all the confidential data is stored in encrypted format. This is system is very much robust and even uses OTP

verification to make sure there isn't any possibility of identity theft.

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