



Original Article

Judicial System Using Blockchain

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Abstract: Blockchain is an incredible invention, the brainchild of an individual known by the pen name, Satoshi Nakamoto. But since then, it has evolved into a technology which holds a vision greater and better than the greatest of creations in the field of technology. A Blockchain is an incorruptible and non-tamperable public digital ledger of data collected through a network. It is how this information is recorded that provides Blockchain its ground-breaking potential. Thus, Blockchain technology provides integrity, authentication, confidentiality and security to everyone on the chain. The Blockchain network has no central authority or governance which is the very definition of a decentralized system. Since it is a distributed and an immutable ledger, the information in it is open for everyone to view. The legal industry has ample of features to gain from the Blockchain by integrating their existing software with Blockchain. One of the main issues of judicial systems today is the management and handling of the evidences. From the time of collection by the court it undergoes a series of ownership and scrutinizing and may lead to manipulations that may be deceitful. Also, the current process is entirely paper based processes and acting on single database system which makes it a single- server model. All the data being stored on to a single server makes the system vulnerable on being prone to attacks and can lead to permanent data loss and not to mention making the process slow. For that purpose, this project deals with successfully embedding Blockchain into the judicial systems for making it even faster, secure and making the people possessing the evidence accountable for their deeds which ultimately leads to provide equal justice to all. Our prototype is entirely developed on the Ethereum private network.

Keywords: Blockchain Technology, Judicial System, Digital Evidence Management, Ethereum Private Network, Decentralized Ledger, Data Security, Smart Contracts, Evidence Integrity.

1. Introduction

The world is experiencing a great pace of globalization and digitalization. An exponentially increasing number of transactions are being carried out online between entities across the world. If the awareness and implementation of the Blockchain technology becomes a world-wide reality, in a not so distant future, most goods, labour and capital will be allocated through decentralized global platforms and thus make the large amount of systems non-tamper able and error free.

The Blockchain is a digital ledger that logs transactions like a book-keeper that can be programmed to record not just financial transactions but virtually everything with a value. This ledger system is of great use to our proposed system, since all the transactions will be logged in the chain, we as a user can make a proper history of the task, which is the most crucial element of our system.

The legal system is currently paper-based that may result in loss of evidences, duplication, errors, which makes the entire process time consuming and may lead to injustice on the path of an innocent. Blockchain could shape law as much as law shapes them. Smart contracts are automatically executed as they are programmed, but it cannot analyze subjective judgments or include elements from outside the Blockchain. Existing dispute resolution technologies are

too slow, too unreliable and too expensive for a decentralized global economy operating in real time. A reliable, transparent and decentralized and accountable dispute resolution mechanism that renders ultimate judgments about the enforceability of smart contracts, key mantra for the Blockchain era.

The sole purpose of our system is to transform the way in which the judicial entities store the data and the evidences, in order to make the system transparent and accountable and tamper-proof.

2. History

2.1. Summary

Judicial System is an important part of democracy and plays a crucial role in how democracy works. In current Indian judicial system, there are two ways that a common man can approach court viz. via advocates or through court officials as represented in figure 1.



Fig 1: General Process to Approach Judicial System

In both the cases, legal procedure is an expensive affair. Common public has no or very limited knowledge about legal proceedings. They completely rely on advocates or court officials for any legal proceedings. There might be various reasons for same such as no legal knowledge, illiteracy, too busy or no interest to gain knowledge regarding legal process and so on. This blind trust on intermediaries might result in expensive dealings or in extreme case, cheating.

- Current Challenges: Below listed are the prominent challenges faced by current Indian Judicial System
- Accountability: None is held responsible for delay in current Indian Judicial System. Even though court officials might be justified in being overburdened, but finally it's the common man getting pissed off.
- Provenance: Provenance of data is lacking currently in Indian Judicial System. Originals can be easily forged and hence, questionable.
- Transparency: Despite having privileges of certified copy for legal documents, Indian Judicial System lacks transparency mostly due to malpractices conducted by court officials.
- Data Integration: Currently judicial officials have data records of only respective zones. Integration of criminal records across country will have better opportunity to track criminals and their past records to restrict unfortunate events in future.
- Scalability: Current judicial system is not scalable enough to maintain record of cases across state.
- Immutable: As with existing databases, Blockchain retains data via transactions. The difference is that once written to the chain, the blocks can be changed, but it is extremely difficult to do so. Requiring rework on all subsequent blocks and consensus of each. The transaction is, immutable, or indelible. In DBA terms, Blockchains are Write and Read only. Like a ledger written in ink, an error would be resolved with another entry.
- Encryption: Standard encryption practices. Some Blockchains allow for "BYOE" (Bring Your Own Encryption). Only as good as the next hardware innovation. All blocks are encrypted.
- Decentralized Peers: Rather than the centralized "Hub and Spoke" type of network, Blockchain is a decentralized peer to peer network. Where each NODE has a copy of the ledger.

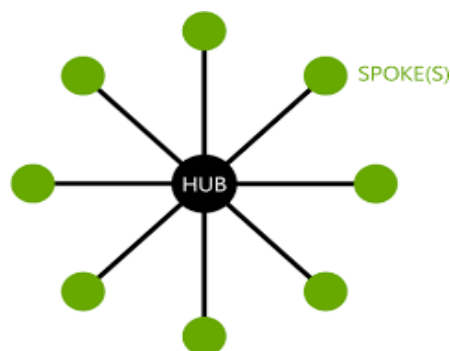


Fig 2: Centralized Db (Legacy Network)

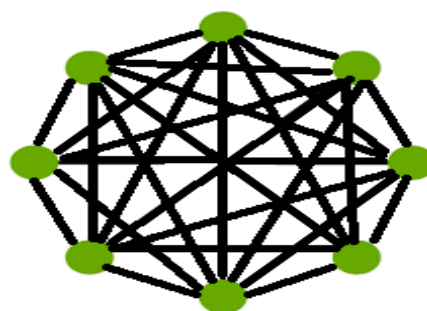


Fig 3: Distributed Ledgers (Blockchain Network)

2.2. Background

In the recent years, with the emergence of the concept of Blockchain and its early use of secure and peer to peer transfer of money in terms of crypto currencies has been one of the widely witnessed phenomena globally. Ethereum was setup based on the Blockchain technology which made it efficient and secure for developing decentralized applications by setting up a private network on determining the consensus. There are about 3 crore cases currently pending in Indian courts, including 42.5 lakh cases in high courts and 2.6 crore cases in lower courts. Even if 100 cases are disposed of every hour, it would take more than 35 years to catch up. For this purpose, this project deals with creating a smart contract that will overcome the drawbacks of the current judicial system using Ethereum networks for fast judgments, reducing the paper work and bringing transparency in the overall system.

2.3. Problem Definition

In the current law and order, the system is purely paper based processes. This might result in the loss of evidence, duplication, tampering, and errors and may lead to injustice on the path of an innocent. Using traditional database system can definitely pose a problem in future as it can be hacked, also it would not be possible to access the data when the server is down. Single point of failure can lead to permanent data loss which can be fatal for data critical tasks. The existing system has no facility to provide versioning of the evidences and is not immune to evidence tampering.

2.4. Proposed Aspects of the Project:

The proposed system will consist of a private Ethereum network connected to different nodes. The data will be stored

on a decentralized file storage system (Interplanetary File System) and the hash of the evidence will be stored on the chain. It consists of python flask as a micro-framework. It will allow the user to create and upload the evidence and also transfer its ownership to another user in the network. The user will be able to see the timeline of the evidence's custody in the update chain of custody module. These evidences will be stored in the IPFS and the hash associated with the evidences will be stored in the private Ethereum Blockchain. The evidences can be retrieved using the hash from get evidence module.

Ethereum private network is to be set up as fully public and uncontrolled network might cause delay in committing transactions. By setting up private network it makes it simple and fast for the users to create evidence and upload them with minimal gas consumption and also causes no delay. The smart contracts are written in solidity language. The interface is designed using Flask which is python-based framework. Python flask used for designing the frontend can be used for storing files and retrieving hash of the files uploaded in IPFS and that hash is uploaded in the network by using web3.py.

3. System Analysis

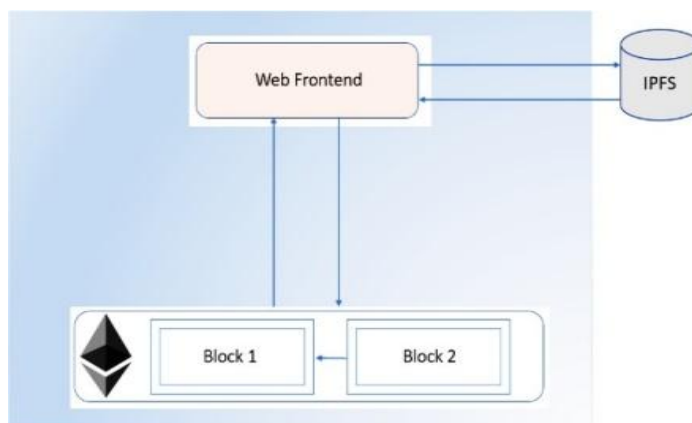


Fig 4: Architecture of a Blockchain-Based Dapp with IPFS Storage

The user once registered in the network, will be able to perform various functions related to evidence. On performing any function, the transaction will be initiated and the mining of the transaction into the block will confirm the transaction. The evidence submitted or changed will be sent to IPFS, on sending the data, a hash will be generated. The IPFS hash will be stored in the blockchain with the wallet address that is logged in to the system.

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3.1. Methodology Used

The proposed system will consist of a private Ethereum network connected to different nodes. The data will be stored

3.2. Algorithm

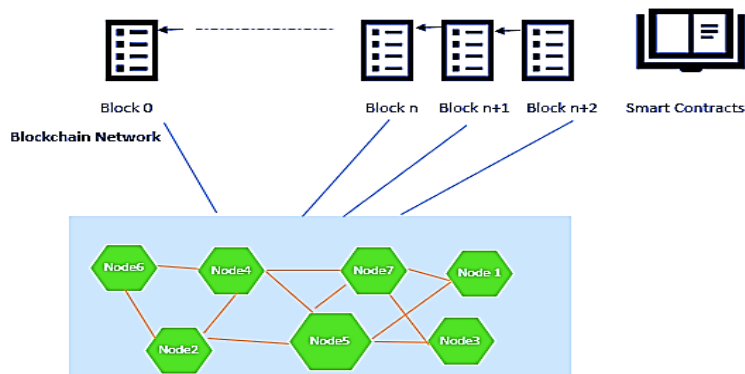


Fig 5: Blockchain Network Architecture with Distributed Nodes and Smart Contracts

3.3. User Interface Design (Snapshot)

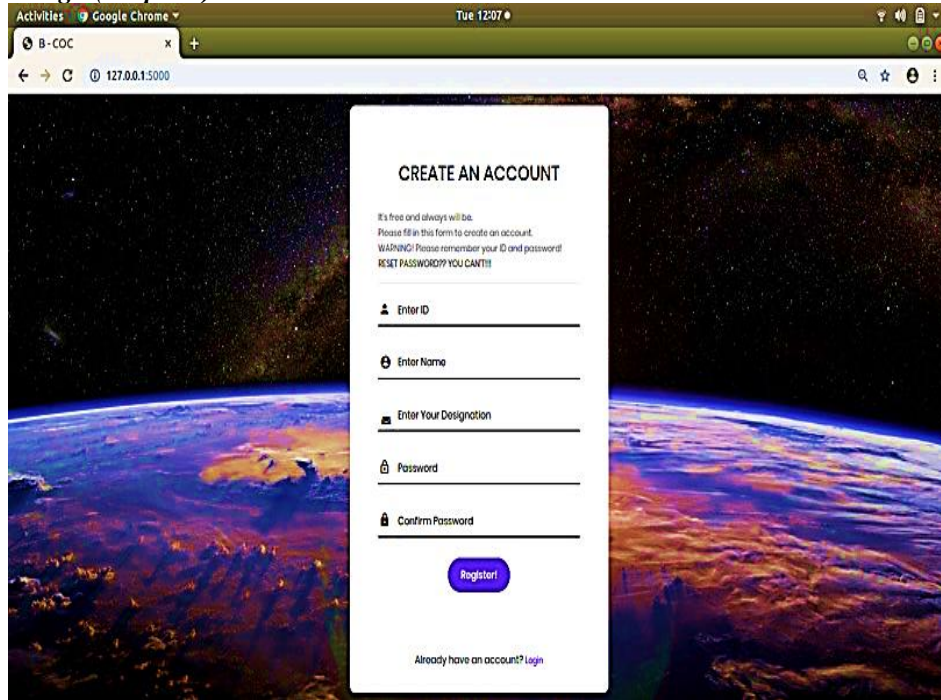


Fig 6: Create Account

MENU

LOGOUT

CREATE EVIDENCE

Name and Title of Person Receiving Item:

Address: Evidence ID:

Location from Where Obtained:

Item Description:

Date Collected: Time Collected:

CONTACT DETAILS

Collection Technician Name: Evidence ID:

Fig 7: Create Evidence

```

pratish@pratish-Inspiron-7559: ~
File Edit View Search Terminal Help
pratish@pratish-Inspiron-7559:~$ ipfs daemon
Initializing daemon...
go-ipfs version: 0.4.22-
Repo version: 7
System version: amd64/linux
Golang version: go1.12.7
Swarm listening on /ip4/127.0.0.1/tcp/4001
Swarm listening on /ip4/192.168.0.34/tcp/4001
Swarm listening on /ip6>:::1/tcp/4001
Swarm listening on /p2p-circuit
Swarm announcing /ip4/127.0.0.1/tcp/4001
Swarm announcing /ip4/192.168.0.34/tcp/4001
Swarm announcing /ip6>:::1/tcp/4001
API server listening on /ip4/127.0.0.1/tcp/5001
WebUI: http://127.0.0.1:5001/webui
Gateway (readonly) server listening on /ip4/127.0.0.1/tcp/8080
Daemon is ready

```

Fig 8: IPFS Daemon

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pratish@pratish-Inspiron-7559: ~/BCOC/bcocETH
File Edit View Search Terminal Help
coinbase: 0xa4492ff2237551ed8386c6d84bfa3df1fdeab74c
at block: 199 (Fri, 20 Sep 2019 12:07:22 IST)
datadir: /home/pratish/BCOC/bcocETH/myDataDir
modules: admin:1.0 debug:1.0 eth:1.0 ethash:1.0 miner:1.0 net:1.0 personal:1.0
rpc:1.0 txpool:1.0 web3:1.0

> personal.newAccountINFO [09-22|11:16:23.801] New local node record
    seq=20 id=4a70b95b774adb79 ip=115.96.204.73 udp=30301 tcp=30301
> personal.newAccount("redhat")
INFO [09-22|11:16:35.970] Your new key was generated          address=0x99f60721463f41f657ff76dc6a41436e13e439c0
WARN [09-22|11:16:35.970] Please backup your key file!      path=/home/pratish/BCOC/bcocETH/myDataDir/keystore/UTC--2019-09-22T05-46-34.453683960Z--99f60721463f41f657ff76dc6a41436e13e439c0
WARN [09-22|11:16:35.970] Please remember your password!
    "0x99f60721463f41f657ff76dc6a41436e13e439c0"
> personal.listAccounts
["0xa4492ff2237551ed8386c6d84bfa3df1fdeab74c", "0x29819710fe983deef22cb9ef2d8bc4412dad26", "0x5b877dac224097753267413e785b866a7a630b3b", "0xfdb66bc835e9b8232c203752c49e36899fccfb08", "0x6b7f5f21bb9cf651dd78c2c6b7a756d26e2b3f57", "0x99f60721463f41f657ff76dc6a41436e13e439c0"]
> personal.unlockAccount(eth.accounts[0],"redhat",0)
true
>

```

Fig 9: Geth Console

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pratish@pratish-Inspiron-7559: ~/BCOC/bcocETH
File Edit View Search Terminal Help
alhash=c6ec21..006123 uncles=0 txs=0 gas=0 fees=0 elapsed=2.000s
INFO [09-22|11:25:52.819] Successfully sealed new block          number=478 se
alhash=c6ec21..006123 hash=dc2633..472742 elapsed=2.335s
INFO [09-22|11:25:52.819] ⚡ block reached canonical chain          number=471 h
ash=1cd68d..f4df80
INFO [09-22|11:25:52.819] ⚡ mined potential block          number=478 h
ash=dc2633..472742
INFO [09-22|11:25:52.820] Commit new mining work          number=479 se
alhash=9edae7..d624e0 uncles=0 txs=0 gas=0 fees=0 elapsed=305.498µs
INFO [09-22|11:25:53.756] Your new key was generated          address=0x03A
b5C8Ac700C9d8118a3434d397D5c06434E067
WARN [09-22|11:25:53.756] Please backup your key file!      path=/home/pratish/BCOC/bcocETH/myDataDir/keystore/UTC--2019-09-22T05-55-49.359051409Z--03ab5c8ac700c9d8118a3434d397d5c06434e067
WARN [09-22|11:25:53.756] Please remember your password!
INFO [09-22|11:25:54.498] Successfully sealed new block          number=479 se
alhash=9edae7..d624e0 hash=0ac77e..6c496d elapsed=1.677s
INFO [09-22|11:25:54.498] ⚡ block reached canonical chain          number=472 h
ash=86450a..d5f340
INFO [09-22|11:25:54.498] ⚡ mined potential block          number=479 h
ash=0ac77e..6c496d
INFO [09-22|11:25:54.499] Commit new mining work          number=480 se
alhash=5ebdae..66e58c uncles=0 txs=0 gas=0 fees=0 elapsed=546.12µs
INFO [09-22|11:25:55.192] Successfully sealed new block          number=480 se

```

Fig 10: Mining Transaction.

4. Conclusion

There are a lot of cases in our country for which justice is delayed. Judiciary is one of the strongest pillar in a democratic country. Our system is capable of reducing this delay to a considerable level as our current system is being exploited by many advocates and court officials. Current Indian Judicial System lacks accountability and transparency which will be provided by our system. Our system comprises of immutability for tamper-resistant legal record storage and management.

Once uploaded into the network no one can modify, delete that evidence and once a new entry is added one cannot deny the existing ones. Our system has eliminated the paper-based processes which will not lead to loss of evidences, duplication, tampering and errors. Our system will also assure that evidence once uploaded in private network will not be tampered or deleted. Our system makes the evidence traceable and secure. Our system will benefit the society at large level. Just as Bitcoin brought "banking for the unbanked", our system has the potential to bring "justness for the unjustness" using blockchain.

Acknowledgment

The success and final outcome of this project required guidance and assistance from many people and we are extremely privileged and honored to have completed the project successfully.

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