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NPA Management using Blockchain

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ABSTRACT

The usage of Blockchain Technology has been increasing rapidly across the various business sectors. Multiple industries across various sectors are adopting it for its immutability, transparency, tamper proof-ness and its distributed nature. As such, banking industry is looking at it intently to solve a variety of problems it currently faces. One of them is NPA management. Especially in India, this is a big issue as the rate at which NPAs are growing is very high. This paper aims to find a potential solution to this problem by developing a blockchain model conceptually which uses smart contracts to effectively manage NPAs. Timers or Loop code concept in a smart contract has been utilized to keep track of a loan as it becomes an NPA. Different scenarios have been provided to explain the working of the concept. An example use case has been elaborated upon as well. The paper developed a conceptual model that is effective in managing NPA as well as it provides a scope for government, NPA as well as external auditors to monitor the state of NPAs of a bank. This paper also provides the scope to further develop the model by creating a working blockchain based model.

Keywords: *Blockchain, NPA (Non Performing Asset), Smart Contract, Timers, Conceptual Model*

1. INTRODUCTION

1.1 Blockchain Technology

The blockchain technology was unveiled to the world in late 2008 and it came into force in 2009 to run the Bitcoin cryptocurrency network. The most salient feature of this technology was that it eliminated the need for a third-party trust by banks and government institutions for transaction of currency value. This potentially marks a huge shift from the way banks and other institutions will operate in the future. A blockchain is basically a distributed ledger of transactions. As transactions are made the are added into the ledger, which is then packaged into blocks by specialized computers called miner nodes. Each block is linked to the next, thus forming a chain of blocks called blockchain. People and institutions who do not know or trust each other, reside in different countries, are subject to different jurisdictions, and who have no legally binding agreements with each other, are now able to interact over the Internet freely without the need for a third party.

Source: www.alextapscott.com

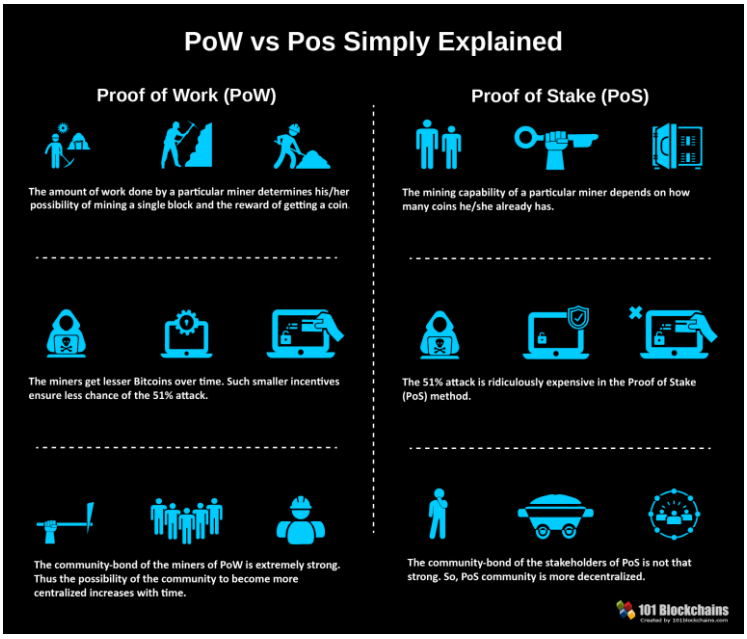
The blockchain technology has solved the problem of the centralized storage system and information management. Data is now stored on a decentralized ledger and a copy of which is available with all the nodes/computers in the network. This makes the system secure because now the entire data is available at various locations and so, this makes it cryptographically much more secure than the traditional method.

It also manages to solve the double spending problem by having an interconnected P2P or peer-to-peer network and management. Bitcoin network was the first instance of a successful implementation of a network that managed to solve this problem successfully.

So, a blockchain, as the name suggests, is a chain or connection of group of transactions called blocks, sequentially. All the data of transactions are grouped together into blocks and are interconnected with the other blocks in a sequential fashion. This ledger of information is distributed across the network to all computers/nodes within the network who can easily access and read its contents but are not able to change the existing data. New data can be added by a consensus mechanism by special nodes called miners. This ensures that there is no Double spending. Miners are systematically rewarded as and when they solve a computationally difficult puzzle in order to create a new block.

Source: www.forbes.com

In a distributed database, the data itself is distributed but it is operated upon by a single organisation. But in the case of blockchains, we have the concept of distributed control. There is no necessity of a central administrator as different institutions as well as people, who do not trust each other, are now able to independently share information. This becomes handy in inter-organisational setups where each institution wants to keep management of their data independent and separate. It has been compared to a spreadsheet in the cloud but the difference being that a copy of the spreadsheet is individually maintained by each entity involved in the cloud. It is regularly updated as new data is entered into the network by its own mechanisms which ensure that data is not manipulated. Blockchain, by its nature, acts like a digital notary and also a publicly verifiable timestamp. This enables us to replace the role of many trusted intermediaries. Therefore, this protocol has allowed to bring about a new form of data management as a backend service of the Internet.



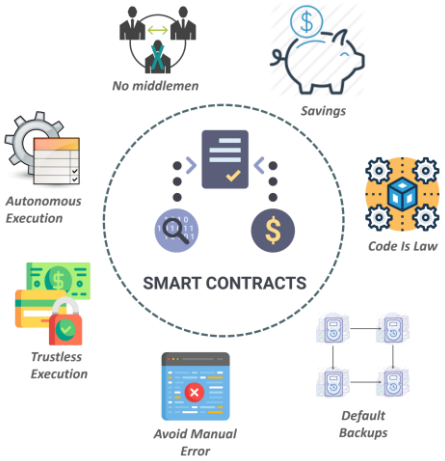
Source: 101blockchains.com

We now talk about the method which makes the distribution of data in the blockchain possible, namely the "Proof-of-Work" mechanism. Basically put, it is the consensus mechanism that makes it possible for distributed control over the ledger. It is built upon the basis of monetary payments as well as cryptography. Reverse game theory is employed in order to reward miners with the native reward token in the blockchain, as an economic benefit. It is a computationally intensive process to find out the solution and be enabled to create the next block. This too has to be verified by all the miners.

1.2 Smart Contracts

These are pieces of code running on top of a blockchain network, here the digital assets are controlled by the same piece of code which exercise some predefined rules. These have the properties of contractual agreements but they must not be thought of as legal contracts.

When all the parties bound to the smart contracts fulfil their obligations, the smart contract will auto-execute the said transaction. The benefits of these smart contracts are that they provide better transaction security than traditional contract law and also help to reduce the transaction costs



Source: edureka.co

It is possible that with the advent of smart contracts and blockchain, the services of lawyers, brokers, bankers and even public administrators may no longer be needed. Transactions could now be done on the blockchain network with very less friction and the costs of transactions would be minimum.

Thus, "trust" would be something that would be handled by lines of code on the blockchain network instead of intermediaries.

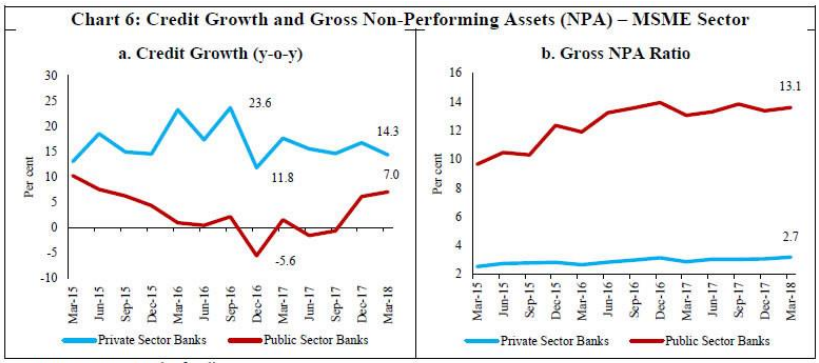
For example let Alice rent an apartment from Bob. Alice can do this through the blockchain by paying the money in cryptocurrency. Alice gets a receipt which is held in the smart contract that is virtual. Bob has to give her the digital entry key, which should come to her by a specified date. If the key doesn't arrive on time, the blockchain releases a refund. If the key is sent prematurely, the smart contract will hold it until the due date. When the date arrives, the key will be released to Alice and Bob will receive the funds and this is automated. The premise on which it works is a If-then premise and being on the blockchain the event is recorded throughout the network and so there can be no scope for manipulations. If Bob gives the key, he is sure to be paid. If Alice sends the required amount in Crypto currency, she gets the key. If key is not sent, or payment is not done, transaction gets cancelled. Once the exchange is done, the smart contract terminates. The code cannot be interfered with by either of them without the other knowing as all the participants are simultaneously alerted.

1.3 NPA

A nonperforming asset or NPA refers to a category of loans or advances that are either in default or in arrears. A loan is said to be in arrears when principal or interest payments are considered to be late or missed, while a loan is said to be in default as and when the lender considers the loan agreement as broken and so debtor defaults on meeting his obligations.

Source: gartenpflege-schmitt.ch

We consider different kinds of non-performing assets or NPAs based up on how long they are categorised in the NPA category.

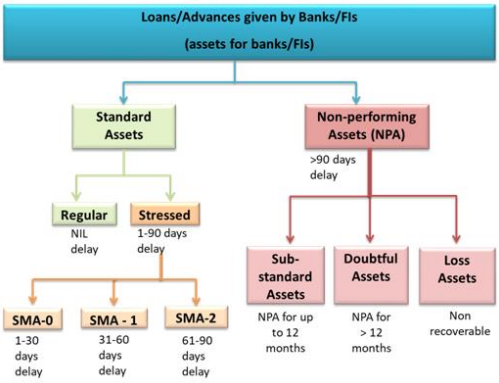


Source: Reserve Bank of India

1.3.1 Sub-Standard Assets: An asset can be classified as a sub-standard asset if it stays as an NPA for a time period of less than or equal to 12 months.

1.3.2 Doubtful Assets: An asset can be classified as a doubtful asset if it stays as an NPA for more than 12 months.

1.3.3 Loss Assets: An asset will be considered as a loss asset when it becomes "uncollectible" or has such low value that its continuance as a bankable asset won't be suggested. However, there could be some recovery value remaining in it, as the asset has not been written off entirely or in parts.



Source: ixambee.com

1.4 NPA Provisioning

Provisioning basically means an amount of money that the banks usually set aside from their profits or income during a particular quarter for these non-performing assets; such assets that may turn into losses in the near future. It is a method by which the banks allocate resources for the bad assets and to sustain a healthy book of accounts. Provisioning is done on the basis of which category the asset is affiliated to. The categories have been discussed in the above section. Based on not only the type of asset, provisioning also depends on the type of bank as well. For example, the Tier-I banks and the Tier-II banks have quite different provisioning norms. It has become very important to automate the process of NPA recognition. This is visibly clear from the following diagram which highlights the push by RBI for the same. Using automation, a smart solution can be obtained which has been broadly demonstrated in the Thesis.

Source: affairscloud.com (Sept, 2020)

High NPAs usually are not be favourable for any bank. This is because these NPAs are assets that are not performing. High NPAs indicates that these banks have too many loans that have transformed into non-functional or are not rendering any interest income to them. Banks can either prolong the NPAs in their books in the hope that they may be in a position to recover it or make provisions for it in the future. Otherwise, the banks write off the loans entirely as bad debt. However, there are many other factors to assess any bank apart from NPA. All these factors must be taken into consideration together.

Literature Review

This chapter reviews the relevant literature on Blockchain Technology, beginning with the basics of what the technology constitutes of, i.e., its principles and concepts, moving on to briefing on some of its examples and use cases and finally discussing how it can impact the financial sector and services in India

Blockchain technology was first conceptualized by a person/group under the pseudonym of Satoshi Nakamoto (Identity still unknown!) in 2008 as an alternative to counter the financial crisis. They introduced the digital cryptocurrency Bitcoin as an alternative to the regular currency and, blockchain would be the ledger where all records of bitcoin transactions would be stored. (Nakamoto, 2009)

A Blockchain can be understood by the following explanation. It is a distributed database of different records, or a public ledger of all transactions or digital events which have been successfully completed and these records are shared among all the participating entities or nodes. (Crosby et al., 2016) Transactions are clubbed together into blocks and these blocks are linked together by hashes forming a chain of blocks. Hence the name Blockchain.

Blockchain brings several advantages to it. Each participating node has a copy of the blockchain. So, the whole system by nature is decentralized. Further each transaction needs to be verified by consensus of a majority of the nodes to be considered valid. (Tschorsch & Scheuermann, 2016; Weber, 2018) Also, to break the system, any attacker needs to take control of at least 51% of the nodes to influence the chain. This is highly unlikely and near impossible to occur, especially for a large network. Once the information is stored in the blockchain, it can never be deleted, i.e., it is immutable. Bitcoin, the decentralized cryptocurrency has been developed on top of Blockchain. (Parker, 2018; Tschorsch & Scheuermann, 2016)

Blockchain Technology was further developed to execute Smart Contracts on top of it. Nick Szabo introduced this concept in 1994 and defined it as "a computerized transaction protocol that executes the terms of a contract" To put it simply, a Smart contract is a piece of code that facilitates transactions only upon completion of the stipulations coded in the smart contract. It resides in the chain and can be accessed only by its specific address. (Christidis & Devetsikiotis, 2016; Luu et al., 2016). This is particularly useful for making deals and transferring money during transactions when special conditions/rules are involved. This was successfully implemented by a Canadian programmer named Vitalik Buterin in 2015 in his Ethereum blockchain . (Buterin, 2014)

Blockchains are of three types: Private, Public and Consortium blockchain. Differences lie w.r.t who can access the network, who has access to making consensus, transactions, etc. (Dinh et al., 2017) Companies can obtain benefits by utilizing various types of Blockchains, according to their needs. Blockchain is already delivering a massive impact on various segments of the society. Blockchain technology is seeing widespread acceptance in various sectors be it financial services sector, land title registry, Supply chain management, contract and vendor management, energy utilities, copyrights, voting, mitigating and identifying fraud, real estate sector, etc.(Abou Jaoude & George Saade, 2019; Aste et al., 2017; Berryhill et al., 2018; Bhatia et al., 2019; Jain et al., 2020; Rogerson & Parry, 2020) In all these cases it has been shown how Blockchain can be implemented to make these processes more efficient. Blockchain in combination with IoT can really make IoT faster and much more secure and efficient(Rane & Narvel, 2019) Even for a green and sustainable future of businesses, Blockchain and IoT together can be of potentially great use. (Rane & Thakker, 2019)

In the financial sector, Blockchain enabled with Smart Contracts has the potential to disrupt the entire industry. Blockchain has the potential to make the function of intermediaries redundant and irrelevant and so in this sector, blockchain has to be recognized and understood by the current players urgently and properly.(Casey et al., 2018) Blockchain has also started to be implemented in various financial stock markets over the world as well. (Yoo, 2017) Even in banking sector for example, various services can be rendered cheaper and more efficiently due to application of Blockchain. These include bill operation, cross-border payment operation and asset securitization business (Cocco et al., 2017; Wu & Duan, 2019) Further, blockchains can store records of transactions as and when they happen, which are signed by both parties involved; this significantly reduces reliance on internal records and their veracity while auditing. The blockchain based ledger will be signed by both parties and time-stamped for authenticity.(Mantelaers et al., 2019) Even in simple or electronic marketplaces, blockchain has the capability to enhance transactions by increasing privacy, efficiency, reduce need for intermediaries and trust and enhance the safety of the records. (Subramanian, 2017)

In finance, blockchain can trump the traditional system because of the following reasons: (Petrov, 2020; Tapscott & Tapscott, 2017)

- **Distributed Database**: The database is not located in a centralized place, but the entire database is distributed among various nodes such that there is no need for intermediaries to grant access to data.
- **Peer-to-Peer Transmission**: A transaction can occur directly between parties without interference of intermediaries and this data is transmitted directly across the network.
- **Transparency with Pseudonymity**: Every transaction and its associated value are visible to anyone who has access to the system. The details of the transaction can be visible or encrypted depending on the agreement. Further, it is time - stamped. Users can also be anonymous or provide proof of their identity to others. Transactions occur between the blockchain addresses (Rana et al., 2019)
- **Irreversibility of Records**: After the transaction has been updated in the record, it cannot be changed because it gets linked to every other transaction in the database via hashing algorithm.
- **Computational Logic**: Users can set up various algorithms and rules that are coded to automatically trigger transactions between nodes. (Smart Contracts)
- **Trust free system**: Assets like money, equities, bonds, contracts, and almost all other kinds of assets can be transacted and traded securely, privately, and from peer to peer, as trust does not have to be established and maintained by the governments, banks and powerful intermediaries by it is automatically created by network consensus, cryptography, collaboration, and clever code. Businesses or individuals can transact with each other without having to rely on intermediaries and the issue of trust is also resolved.
- **Reduction of Transaction costs**: As removal of intermediaries reduce transaction costs greatly, it greatly benefits the transacting parties who adopt the peer-to-peer system to get their transactions cleared.

In India unfortunately, despite all the advantages provided by the blockchain, a lot of steps need to be taken by the government to implement this ground-breaking technology. So far, some steps have been taken at the state level like creation of Land title Record ledger in Uttar Pradesh, Haryana (Oprunenco & Akmeemana, 2018), Andhra Pradesh, Maharashtra and Telengana. (Gupta et al., 2020) In Telengana it is also planned to make a blockchain district in the city of Hyderabad. Organ Transplant data is also being recorded using blockchain in Maharashtra. (Kshetri, 2018). Various businesses in India have implemented Blockchain technology for many purposes, which highlight the understanding that they have for its use and benefits.

1) ICICI Bank and Emirates NBD have announced a pilot launch of a blockchain network for international remittances and also trade finance.
2) The Mahindra group and the global IT solution provider IBM, have announced their intention to develop a cloud-based blockchain-backed supply chain finance application which has the potential to reinvent the supplier-to-manufacturer finance transaction system in India.

3) Bajaj Electricals, in 2017, announced their using of blockchain with smart contracts in the area of vendor / supplier financing. With the support from Yes Bank, IBM and a fintech start-up, Cateina Technologies, Bajaj Electricals has been able to cut down its payments processing time from four to five days to near real time.
4) Bankchain, a community of banks, came together to explore, build and implement blockchain technology for its use in the banking system with a main goal of information sharing between banks so that fraud handling and documentation sharing becomes simpler to handle.
5) IDRBT Whitepaper – All the readily usable cases presented in this whitepaper demonstrated how blockchain can be utilized for information sharing and digital currency based applications. (Manda & Polisetty, 2018)
6) The Tea Board of India is planning to use a blockchain ledger for recording its activities. This way, customers will be able to trace poor quality products back to the plantations through the ledger
7) The state of Kerala is planning to establish itself as the blockchain hub of India.

In spite its potential and benefits, blockchain does have its fair share of concerns. There are issues regarding the ownership and maintenance of a blockchain since it is distributed, the current consensus protocol consumes a lot of energy, smart contracts could be a problem as smart contracts are as efficient as the designer who coded it, interconnectivity of blockchains and also communicating with an off-chain database. (Gatteschi et al., 2018; Suominen et al., 2018) In comparison to the traditional financial security standards, some aspects of blockchain still need some work.(Bello & Perez, 2019) So, with recent and continuing developments these issues are being tackled very strongly and considerable progress is being made. (Wang et al., 2018) Legal and ethical issues (George et al., 2019; Tang et al., 2019) still need to be resolved in order to be able to use this technology for the benefit of mankind but a long road has been traversed since the time when, using blockchain technology bitcoin was being used in the black market, to being a technology no business or government in the world can take lightly.

2. RESEARCH GAP

What the review of the literature suggests is that research on blockchain has been actively going on in various fields ever since its inception and newer and newer applications are coming out. Blockchain is stated to disrupt the financial services greatly and so, naturally it is being dismissed, questioned or treated with immense scepticism and mistrust by most of the traditionalists. In India, only recently activities relating to blockchain have been given a green signal by the authorities. There is a lack of thorough research done with regard to the financial sector especially, managing NPAs using Blockchain. So, this opens up possibilities of developing concepts of robust blockchain models in the financial sector particularly for managing NPAs, which are compliant with Indian rules and regulations and yet can avail the benefits of this novel technology.

2.1 Research Question

In the Indian Context, can an alternative method to managing NPAs be developed, using Blockchain Technology?

2.2 Latest Developments

Some of the latest developments in the field of Blockchain and Cryptocurrency are:

1. As the price of the world's leading cryptocurrency has been leading recently, the Indian Government is considering levying the GST or Goods and Services Tax of 18% on all Bitcoin Transactions as a measure to earn from it. Just by imposing the tax, the government could earn more than Rs 7,200 Cr annually from the GST.
2. UNICAS is a joint venture between the companies Cashaa and United Multistate Credit Cooperative Society. On 30th December, 2020, they announced the launch of the world's first physical branch of a cryptocurrency bank in Jaipur, India. They plan to launch its services in 14 more branches by January 2021.
3. Countries all across the world in 2020, have been in the race to develop their own CBDC, that is their Central Bank Digital Currency. Bahamas already launched its CBDC, the Sand Dollar, while among the major countries, China has been the closest to releasing its own CBDC.
4. Another trend that was seen in 2020 was the upgrading of digital currency service providers to fully nationalised banks where Kraken Financial was the first company to do so. This enabled seamless banking between digital assets and national currencies. It allows the digital currency service providers to operate in any part of of the US without having to apply for license in each individual state. Other than Kraken, Avanti also received a state charter, and Paxos and BitPay filed with the Office of the Comptroller of Currency to become National Banks.
5. Tokenised stock trading was another service that was launched by the service providers such as FTX and Bittrex. Users could now trade shares of stocks over the blockchain, that were pegged to the value of the underlying stock. The advantages are that the banks could save a lot of money by using cryptocurrency and transactions are much faster on a blockchain based network.
6. Further, Banks have started using blockchain and stablecoins for their payment settlement purposes. JP Morgan have launched a new blockchain unit entirely for this purpose.

3. MODEL

The following section attempts to create a simple model which illustrates how blockchain technology, using smart contracts can be used by banks to monitor and track their NPAs. Using an immutable blockchain ledger and smart contracts, NPAs can be tracked in real time and recorded permanently in the blockchain network. This allows regulators to keep a tab on the NPAs accumulated by the bank, as well as provide a robust mechanism to the banks to keep a trace of the NPAs as it progresses. Thus, this system benefits both the bank as well as the auditors, government and other regulators. Given below are the assumptions made before attempting to develop the model, followed by the steps in which the model would operate, an example use case of how the model will operate and 3 different scenarios covering the various aspects of how the model would handle the various situations.

3.1 Assumptions

1. The blockchain will be a modified one to record loans or advances taken, as transactions on the blockchain. This will also activate a smart contract.

2. The blockchain also records missed payment dates, payment of installments as well as the final payment which completes the loan repayment, on the blockchain. These are recorded as transactions as well.
3. The blockchain ledger will be available with the external auditors, government (finance ministry), as well as other regulators like RBI. This gives them a scope to independently monitor the NPA activity of the bank from a source where there can be no scope of manipulation.
4. When the NPA stage reaches Loss Assets and there is no scope of recovery of the loan, the bank can write off the loan under bad debts and also close the smart contract manually, thus causing the final transaction for that loan in the Blockchain.
5. The technical design of such a permissioned blockchain with these assumed, modified features is beyond the scope of this Thesis.
6. When some NPA recovery is made, payment recalculations will be done based on which the timers in the Smart Contract code will be recalibrated using clever code. The code for the smart contract can be deliberated upon as a part of further research.
7. There will be use of automation to ensure that when the bank receives instalments, it is automatically updated in the blockchain network. There is no manual interference here, in order to ensure that there is as less scope for manipulation as possible.
8. Mining of the blocks will be done in a "Proof of Stake" Consensus Mechanism and no rewards will be issued to the Miner Nodes, which in this case will belong to the bank.

3.2 Steps of Operation of Model:

The following are the steps in which the model is proposed to operate:

1) Upon receipt of the necessary documents, when a loan or advance is provided, the transaction is recorded on a Blockchain. It automatically triggers a smart contract. [A smart contract works through automated conditional performance. When a contractual obligation is met, the corresponding obligation is triggered. For example, an obligation could be triggered by:

- a specific event ("if X happens, then action Y")
- a specific date or at the expiration of a period of time ("at X date, action Y")]

2) With the necessary inputs, the Smart Contract sets up the timer for the due dates of repayment of loan and waits for the first due date. When an installment is paid, a record is entered into the blockchain. The Smart Contract automatically updates itself on seeing the transaction and waits for the next due date and update of payment. This loop continues for the entire duration of payment till all the installments have been repaid. Records for instalments are entered into the blockchain to ensure that the paid instalment instances are separately recorded on the blockchain as well. [A loop statement in the smart contract code should be able to handle this]
3) The Smart Contract will check each entry in the blockchain to verify whether the concerned transaction has been made, i.e., whether a specific instalment has been made or not. [It will look for an ID in the transaction, which will signal it that the installment has been paid]
4) If there is no update entry in the blockchain on the due date, a separate timer will be set which will run for 90 days and after the period of 90 days, send a signal to the bank that it has been classified as an NPA. If a person pays, the timers get recalibrated.
5) When it is classified as an NPA, it will first be labelled as Sub-standard asset and another timer starts. This timer lasts for 12 months. At its end, if no payment is made, it will be labelled or tagged as a Doubtful asset. It will remain that way until the bank decides that it is a loss asset and updates it so.
6) The process of extracting data with regard to NPAs can be automated with the help of Robotic Process Automation or RPA which can look up the NPAs accumulated within a certain period of time, a single NPA amount related to a loan transaction, or the entire NPAs amount pending, etc. which helps in easy access.

3.3 Example/Use Case

To understand the critical role of timers (or looping code) in the smart contract, a basic example has been designed. It explains how the timers work in the smart contract code and records the payment or non-payment of interest or principle on the blockchain ledger. The example is given below:

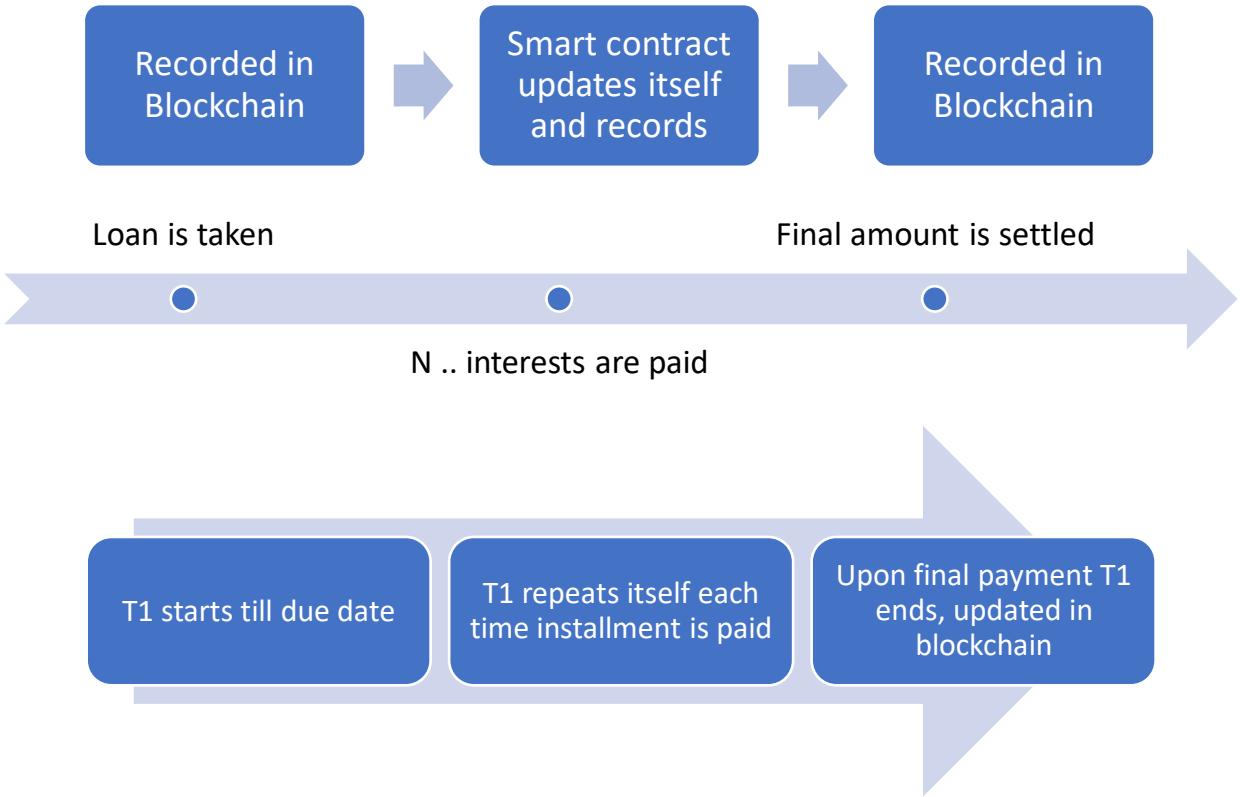
(Looping the timers in the smart contract code.)

Let us consider a Loan where interests are paid **quarterly**, and the principal is paid back in **2 years**.

a) A Loan is taken by a customer from the bank.
b) The transaction is recorded in the blockchain, the smart contract is activated and timer T1 starts which will run for **3** months while waiting for interest to be paid
c) Every time interest is paid, it is recorded in the blockchain and T1 loops starting from the due date of the previous paid interest. It will loop this way for a period of 2 years, i.e., for 8 iterations.
d) If a due date is missed, this is recorded in the blockchain as well and Timer T2 Starts and counts for 90 days, after which the loan is categorized as NPA (Sub-Standard Asset). This information is recorded as well.
e) Timer T2 now counts for 12 months and after 12 months, it records it in the blockchain and recategorizes it as Doubtful asset and runs till the bank categorizes it as a Loss asset.
f) T2 and then T1 will stop once the bad loan has been recategorized as a Loss asset. The Smart Contract ends, and the bank will write it off as a bad debt.
g) If payments are made while T2 is running, T2 loop breaks, and the active timer once again is T1. Payment recalculations need to be fed to the code. These recalculations can be automated or done manually.
h) When the last payment is made T1 will stop. The smart contract will end, and the loan repayment will be deemed as complete.

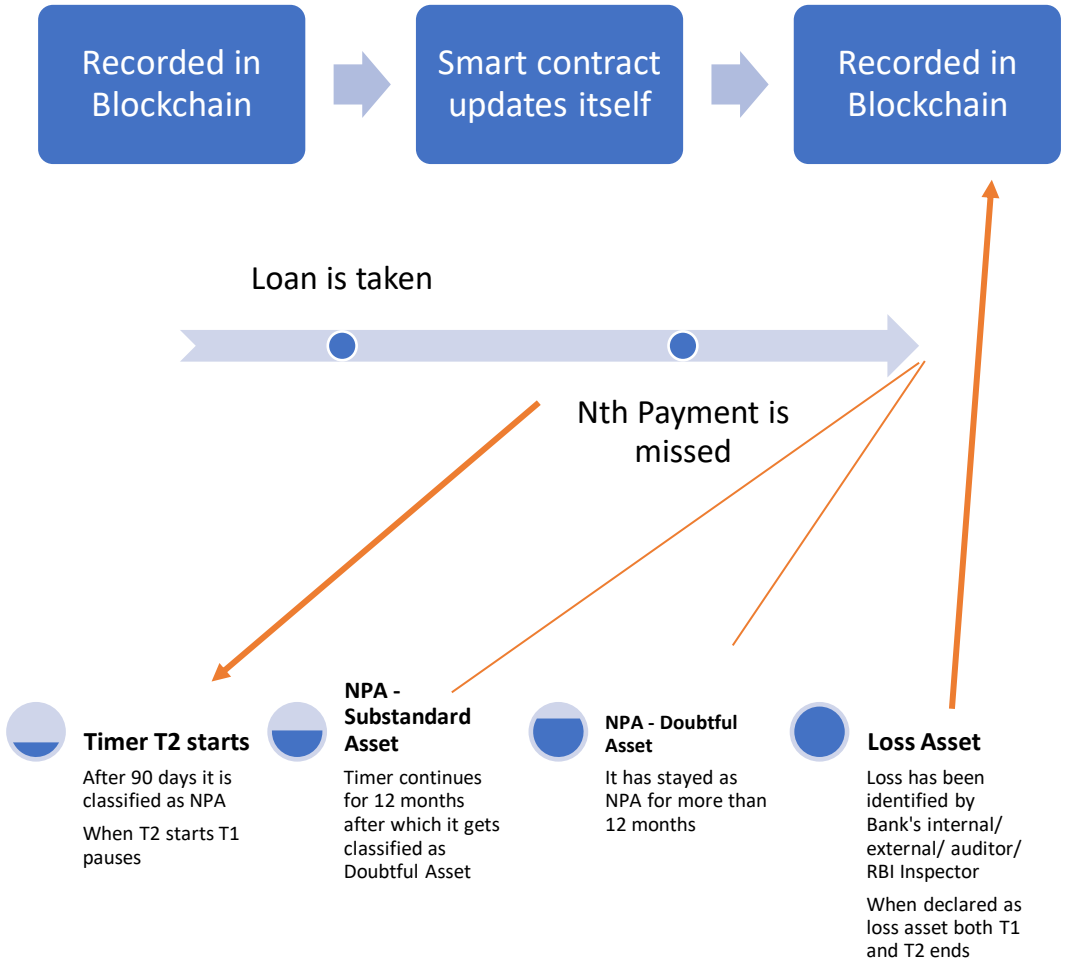
3.4 Scenarios

Scenario 1



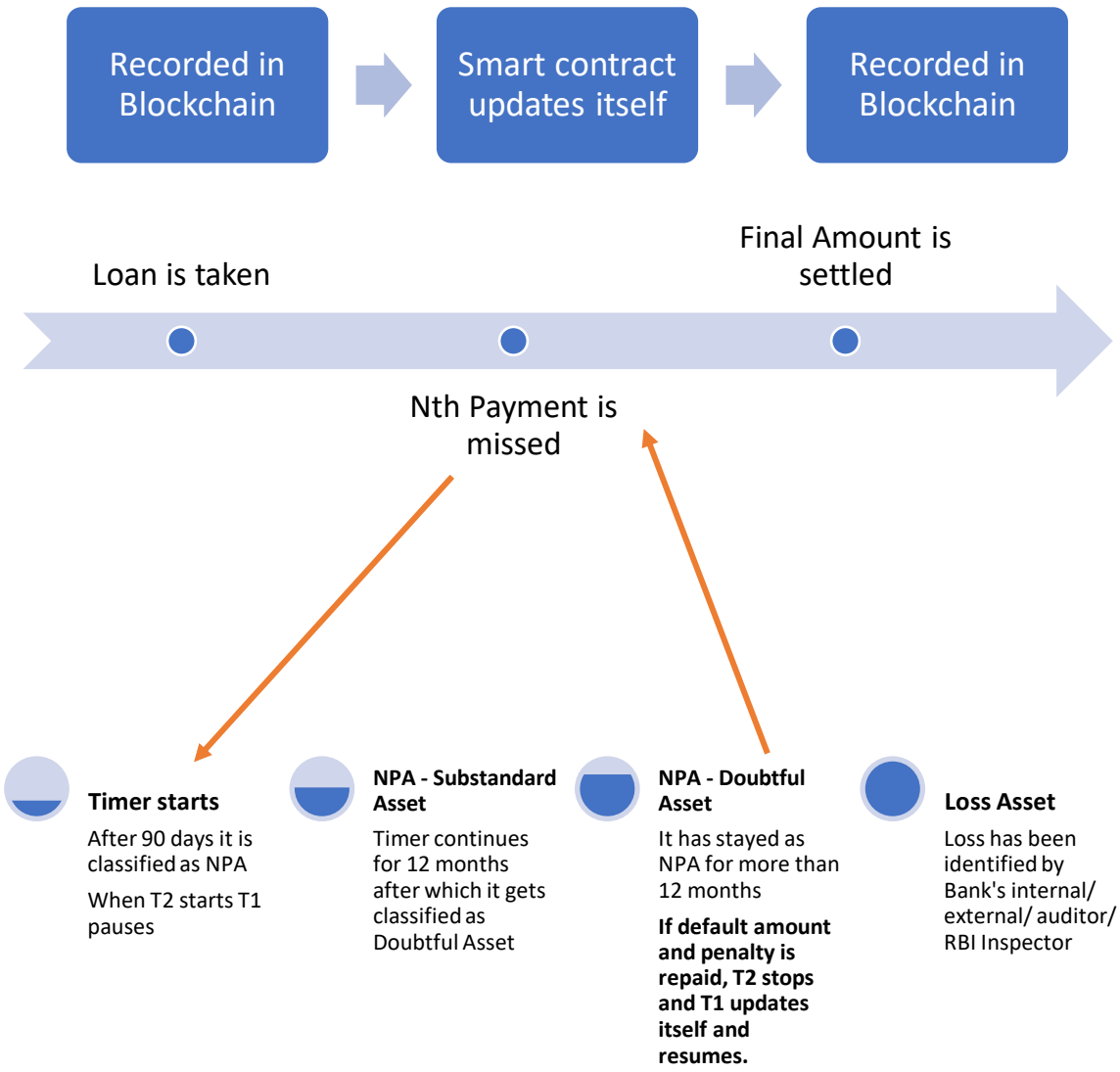
When a loan is taken, details of it is recorded in the blockchain network as a transaction between the bank and the customer. A smart contract gets activated which uses a timer(T1) to keep track of the amount paid as installments. As each installment is paid, it is recorded in the blockchain network and the timer loops in order to keep track of the next installment. When the final instalment is paid, the timer stops and the smart contract, upon fulfillment, gets terminated and the entire transaction is recorded as payment from the customer to the bank. This is the desired situation and the one that the bank hopes for.

Scenario 2



Again, a loan is taken, and the details are recorded in the blockchain as a transaction between the bank and the customer. As usual, the smart contract gets activated. Timer T1 will keep track of the loan repayment instalments. As instalments are paid, it gets recorded on the blockchain and timer T1 is reset. At due date, if payment is missed, it gets recorded in the blockchain and the timer T1 pauses, and T2 starts. T2 runs for 90 days, after which it categorizes the loan as an NPA (Sub-standard Asset). Timer T2 now counts for 12 months and after 12 months, recategorizes it as Doubtful asset and runs till the bank categorizes it as a Loss asset after say, another few months based upon pre-existing rules coded in the smart contract. T2 and then T1 will stop once the bad loan has been recategorized as a Loss asset. The smart contract will get terminated and this data will be recorded in the blockchain network. This record will be available for regulators to check for verification purposes.

Scenario 3



In this scenario, a loan is taken, and this transaction is recorded in the blockchain network and a smart contract gets activated. Timer T1 will keep updating and looping itself and data keeps getting recorded on the blockchain, every time instalments are paid. If at due date, payments are missed, T1 pauses and timer T2 starts. T2 runs for 90 days, after which it categorizes the loan as an NPA (Sub-standard Asset). This information gets recorded in the blockchain as well. If default amount and penalty is repaid, T2 stops and T1 updates itself and resumes. When the final instalment is paid, the smart contract, upon fulfillment, gets terminated and the entire transaction is recorded as payment from the customer to the bank.

The blockchain will keep records of the loans and advances issued and NPAs including the Loss Assets. Being a distributed ledger, internal/ external auditors, RBI and other regulators can have access to it. As the ledger by nature cannot be modified, so data once entered cannot be manipulated or erased. So, this ensures transparency in operations and ensures that NPAs are accounted for fairly and correctly. It can also act as a deterrent for providing unverified loans by banks.

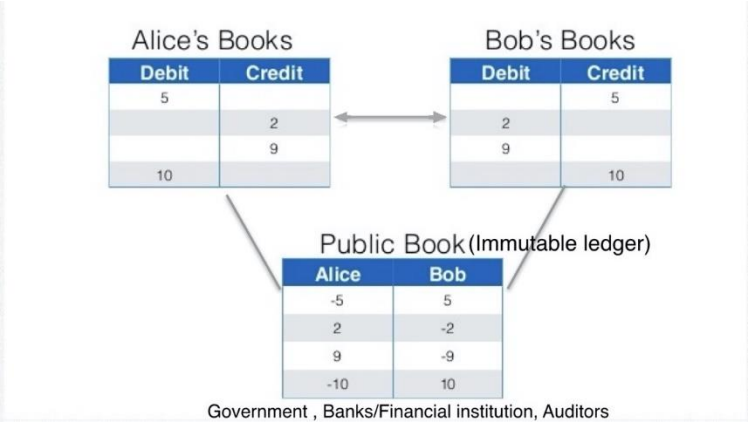
This ledger will be distributed to the auditors and regulators to ensure transparency.
The ledger has an added advantage of being immutable and so the data on the ledger cannot be altered. So, this will ensure that fair practices and standards are maintained while giving loans. If attackers try to hack into the system, they will fail to do so because of the distributed nature of the blockchain network where copies of the ledger will reside all the nodes of the network. If hackers manipulate the node at one point, the other nodes will signal a red flag because data in that node will stand different from the other nodes. Also, the node distribution in the blockchain network can be meted out after through discussions with the authorities

4. DISCUSSIONS AND IMPLICATIONS

The basic idea for the model has been inspired from the proposed usage of blockchain in Triple entry accounting and RBI's diktat to move everything to digital platform by the first quarter of 2021. In this section we discuss the need for the model especially during this pandemic situation, to keep track of provisions, implications etc.

4.1 Triple Entry Accounting using Blockchain Technology

This concept was conceived by the late Yuri Ijiri who was a professor at the Carnegie Mellon University. So, Triple-Entry Accounting gives us a framework to work with a new and complex way of accounting. In the recent years the focus was put on it due to Ian Gregg who associated it with blockchain tech and publicized it in accordance with his belief that accounting should not be completely private anymore.



Source: medium.com

The term Triple-Entry Accounting can be considered as slightly misleading because there is no third entry. Instead, a third component is added to the usual credit and debit system. This component or binding thread is the blockchain and it links the books together and helps in linking two separate double entries and it can be used potentially for external auditing purposes.

So, in Triple-Entry Accounting made very secure by blockchain, a third entry is made in the blockchain ledger. When a contract is signed between two parties and a transaction is made, along with the entries in the accounting books, a digitally signed entry of the transaction is made in the blockchain ledger. This ledger is cryptographically secure and is available for government, regulators and external auditors to view and verify. This makes it impossible for the companies to manipulate or hide their accounting data and entries.

4.2 Reserve Bank of India's view towards Cryptocurrency and Blockchain

The RBI has been very cautious towards the dealing of Cryptocurrency even though its underlying technology, blockchain finds increasing use in more and more business applications. The RBI, in April 2018, had imposed a ban on banks from allowing their systems to be used of cryptocurrency related payments. But even then, individuals could continue to trade using peer to peer networks. However, the Supreme Court, in March 2020, quashed the ban and opened up the formal financial system to trading in cryptocurrency. This has forced the RBI and Government to rethink their view on the possibilities of Blockchain and Cryptocurrency.

4.3 The need for the Model during the pandemic situation

Due to the Covid-19 pandemic situation, which plagued the whole world and caused tremendous loss to life and completely altered the way we function, i.e., staying at home became the norm, wearing masks while travelling out, maintaining physical distancing, lockdowns, became the new way of life. In this kind of a situation, businesses suffered a lot, especially hotels and hospitality, travel, tourism, restaurants, theatre, cinema halls, etc. took a huge hit. Many industries had taken big loans before the pandemic hit but due to lack of production, were unable to repay them. Many industries took loans during the pandemic just to survive. Many businesses even closed down. The Government had announced several measures to help these ailing companies but inspite of that, there were several businesses who took huge blows.

Source: Business Standard

From the banks' perspective, there would be many businesses which would default on their loans. Due to this situation, the NPAs or Non-Performing Assets would rise up substantially in the coming year. Handling all the NPAs would be a tremendous task for these institutions, with the pressure on them ever increasing. There is always a fear that they may have to write off these debts as bad debts and incur huge losses. In such a tricky situation, it is important that banks are able to manage the NPAs in a manner which is reliable, transparent, efficient, and gives a true picture of their status so that they can act upon it.

It is also seen that there is no efficient mechanism available to the regulatory bodies and the government to monitor the NPA activity of the banks. Usually, the RBI acts as the last measure when the bank is deep into trouble. Some banks try to hide their NPAs or conceal it in some fashion, to avoid showing losses. These malpractices usually end up hurting the bank itself and also can lead to negative public perception, mistrust by people in the banking sector.

Source: indianexpress.com

Thus, to avoid these situations, automation of NPA management can be done using Blockchain technology. The fundamental advantage is that it can be constantly monitored if needed, as a copy of the blockchain will always be with the regulator, government, making it impossible to fudge it. This in turn will make the banks much more careful in providing loans to businesses, which will reduce the amount of bad loans given.

4.4 To immutably keep track of Provisions

As a part of RBI regulations, it is mandated that banks keep a certain percentage of funds aside as provisions for NPAs. This percentage is decided by the stage of the NPA, i.e., whether the NPA is in sub-standard stage, doubtful stage or have been classified as loss assets. If it is in the sub-standard stage lesser provisions of around 20% of the NPA have to be made. If it reaches the doubtful stage provisions from 30% to 100% need to be made depending upon the available collateral. If it reaches the loss asset stage and are no longer realizable, 100% provisions have to be made and it will be written off as bad debt.

Another blockchain can be maintained to record the provisions that have been made, against each NPA. When an NPA has been recorded in the other blockchain, it will get recorded here as well, and a smart contract will be activated, which will seek input from the bank regarding the amount of money set aside for provisions. This blockchain will get updated with regard to the status of the NPAs from the previous blockchain and will continuously seek inputs from the bank regarding provisions. The provisions can be made and the amount of extra provision that has been made can be updated in the blockchain in accordance with the progression of the NPA. The details of the provision and the amount provisioned for can be entered into as part of details of the smart contract. The process to extract data regarding provisions can also be automated for easier access. RPA or Robotic Process Automation can be used here to fetch the details of any provision that has been made already, as well as any other data related to it such as the total provisions made by the bank so far and so on. It makes the process a lot easier and quite accessible.

In case the NPA becomes a loss asset, 100% provisions need to be made and it will be written off as a bad debt.

4.5 Implications of the Model

The model gives a simple yet effective solution to managing NPAs of Indian Banks in a transparent fashion which will rely on cryptographic algorithms to keep the transaction data secure, as well as its distributed nature which will keep updated copies of the ledger at multiple locations whilst keeping the contents of each transaction encrypted. The smart contracts will be able to keep track of the NPAs and classify them according to the time period which they have remained as NPA. Looping function in the Smart code have been proposed to carry out this task. The details of this have been provided in the previous section.

As mentioned above, this mechanism will allow the Government, the Regulators like RBI and the External Auditors to have access to the tamper proof copies of the ledger, which they can use to evaluate the NPA situation of the banks in a much more transparent and error free manner. They will be able to monitor the activities of the bank's NPAs on a continuous basis and will be in a position to rebuke the bank for any major abnormalities. This can ultimately even prevent major disasters from happening and also allow the bank to brace for any huge losses. The RBI can direct the bank to take some steps immediately to correct the errors and misjudgments on part of the bank

Source: experfy.com

As data once recorded in the blockchain cannot be removed, its immutability provides clarity to the transactions as well as directions for proper management of NPA by the banks.

Banks will now need to be even more cautious before giving out a loan or an advance because this will get permanently recorded by the blockchain and so regulators will be easily able to trace out the wrongdoings and errors by the bank which could lead to huge losses. They will hesitate before freely handing out big loans to corporations, without properly verifying the details first and obtaining collateral because all this data would be recorded in the blockchain for the regulators, auditors to see and so they would exercise extreme caution. This would benefit the bank itself and prevent it from needing bailouts in the future. Recording the data on the blockchain would also enable the bank to manage and access details of transactions efficiently and effectively.

5. CONCLUSIONS, LIMITATIONS, AND SCOPE FOR FUTURE RESEARCH

5.1 Conclusion

The Thesis provides a conceptual model of a blockchain solution to solving the NPA or Non-performing asset management problem that has been plaguing the Indian Banks. A detailed model has been created which takes care of the various aspects of, and various situations regarding NPA management. The use of Blockchain technology makes the whole process transparent, and unable to be manipulated, which helps the regulators, government and external auditors to keep a tab on the bank's NPA activity. To keep an account of provisions, another blockchain has been proposed to be maintained. The need for the Blockchain based NPA management system and its inspiration, i.e., the blockchain based triple-accounting system has been discussed as a part of the thesis. The view of RBI and the government with regard to blockchain and cryptocurrency has also been discussed. Finally, the implications of the model have been elaborated upon. Overall, it was a truly satisfying journey in the process of writing this thesis and immense knowledge has been gained from it.

5.2 Limitations

The limitations of this paper are described below:

- The code for construction of the Smart Contracts is beyond the scope of this Thesis.
- This is a purely theoretical model that has been created to demonstrate the potential use of blockchain in NPA management.
- Its application is subject to the laws and regulations placed by the authorities of India.

5.3 Scope for future Research

There is tremendous scope for further research in this field as this is currently a big problem that the banks in India are facing. A fully working model can be developed based upon the concept developed in this paper. This model could implement the code that can be used in smart contracts to develop a blockchain network from scratch which would be implementing this model. This model though, can only be fully realized once any bank takes up the concept and applies it to manage their NPAs with due permission and guidance from RBI.

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