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Assessment of Usefulness of Block Chain Technology for Agriculture Application

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Abstract: ***Agriculture is one of the most important sectors in any country. Increase in population all around the world has led to the need to increase the agricultural produce in the farms. To keep up with the growing demands, the agricultural sector is using IT based solutions like softwares, IOT etc. This technology shift has led to many problems as the farmers and the consumers are not aware of the technologies used and there is a possibility of mishandling of data by major stakeholders. Does there is lack of transparency and reliability on the systems used. This has led to financial Exploitation and adulteration in the agricultural industry. New technologies like blockchain can be used efficiently to prohibit such financial exploitation and adulteration. This project uses blockchain Technology the two track all the transactions that take place in the food chain from farmer to the end consumer. The system is made reliable due to the fact that underlying blockchain technology is very secure and hack proof. The data is stored very reliably on each participant's computers so that the data is available with transparency to each user. The underline blockchain Technology makes it possible to add new data into the blockchain and update the participants with the latest data as soon as possible. The project intends to raise alerts whenever any participant is found exploiting the system with higher margins than the threshold. The end consumer can trace back the food chain and hence any possibilities of adulteration or frauds can be traced back into the entire system.***

Keywords: Blockchain, Foodchain, Agriculture, Application, Tracking, Transparency,

I. INTRODUCTION

Agriculture is one of the most important sectors in the world. The agricultural productivity of the nation plays a huge role in the economy, nutrition and health of the population. With the increasing population all around the world, the need for the increase in agricultural produce is even more dramatic.Green revolution and new research in the agricultural sector has helped in increasing the yields from the farms. Agriculture and related sectors are moving towards IT based solutions to manage the increasing workload in the agricultural sector. Increasing use of software, IOT solutions, and even robotics in farming, packaging of foods, etc are playing a huge role nowadays.

This overdependence on it based solutions has also given more control to the software developer and the middleman that uses the software. It has become easy to keep the farmers and the end consumers in the dark due to non compliance of these IT Solutions. As well as, there are no strict methods to track back what has gone wrong in the entire food supply chain. This has created doubts about the transparency, security, neutrality and reliability of all the operations in the supply chain

Blockchain as a Technology has emerged as a very reliable and transparent way of sharing the data within peers. Though predominantly blockchain is being seen as the backbone of the cryptocurrency industry, there are numerous ways the blockchain technology and its features can be used in other industries to secure the data and their transactions. Research in the use of blockchain in the agricultural industry is increasing these days and a lot of areas are still unresearched. There is a huge opportunity for research in the use of blockchain and its features in the agricultural sector including but not limited to food supply chain, iot solutions and data transparency. This research project intends to explore and understand the use of blockchain Technology in the agricultural sector. Broadly, the focus shall be in the use of blockchain to improve data transparency, tracking money exploitation and pressing back adulteration in the food in the entire supply chain. This shall take into consideration All the stakeholders of the food supply chain from the farmers, middleman, food manufacturing companies, distributors, shop owners, and the customers

II. LITERATURE SURVEY

There are major research studies that are happening in the field of use of blockchain in the agricultural sector. Feng[1] Studied the Chinese agri-food markets and provided a novel solution of tracing agri Food Supply using RFID and blockchain. Xie et al.[2] Provided a Secure data storage scheme based on blockchain for Agricultural Products tracking. Patil et al[3] Study the use of lightweight blockchain architecture to provide security and privacy to smart greenhouse farms. Lin et al.[4] Demonstrated the use of blockchain infrastructure Information and Communication Technology as the next step of e-agriculture.

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Carbone et al. [5] Explored the food on demand business model based on quality of experience food matrix using blockchain methodology. Vinod Kumar[6] Research to resolve a major issue in the traditional rice supply chain management and logistics industry through blockchain technology.

"Blockchain in Agriculture: A Systematic Literature Review"[7] Is a literature survey which shows that 60% of the papers are focused on the food supply chain, 50% of the studies in blockchain in agriculture are dominated by Asian community researches especially from China. Only half of the studies address challenges related to privacy and security of the IOT with blockchain technology.

Here is a list of few notable research in the use of blockchain technology in agricultural sector

TABLE I
NOTABLE RESEARCH AND THEIR CITATIIONS

Description	Paper
Provide an agri-food supply chain traceability system based on Radio-Frequency Identification and Blockchain to enhance food safety and quality of Chinese agri-food markets	Feng
Provide a secured data storage scheme based on Blockchain for agricultural products tracking	Xie et al.
Improve the problem of agricultural food supply chain traceability	Tse et al.
Provide security and privacy to smart greenhouse farms through a lightweight Blockchain based architecture	Patil et al.
Demonstrate that an Information and Communications Technology e-agriculture with a Blockchain infrastructure is the next step in the evolution of ICT e-agriculture	Lin et al.
Describe and highlight the gains obtained with the implementation of a Blockchain Business Network for Brazilian Agriculture exports	Lucena et al.
Define a food-on-demand business model based on new Quality of Experience (QoE) food metrics to provide better performing value chains	Carbone et al.
Resolve the major issues in traditional rice supply chain management, logistics industry through of Blockchain technology	Vinod Kumar
Validate the hypothesis that agricultural sector has a great need for information that supports traceability	Papa

III.METHODOLOGY

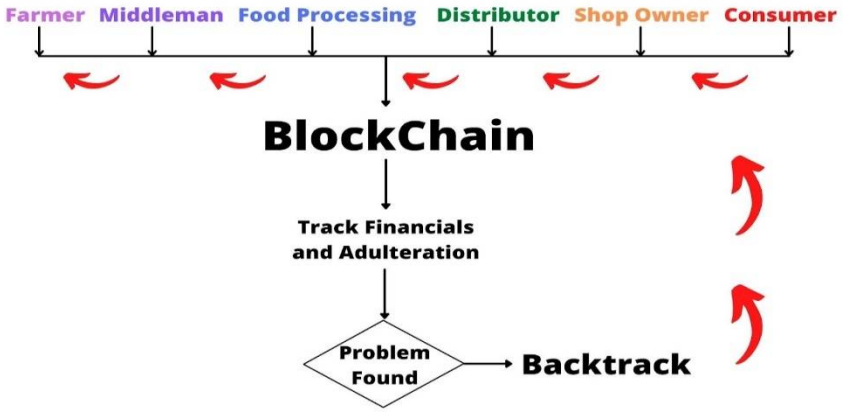


Fig. 1 System flow Diagram

The aim here is to track the financial frauds and adulteration in the entire food chain supply. This includes the full lineup of food chain supply from the farmer till the consumer as shown in the system flow diagram above. The general steps that are followed are as follows

1) All the stakeholders as shown in the system flow diagram shall participate in this process.
2) Transactions from farmer to middle man would be considered as the Genesis block in the blockchain. a unique ID will be generated for this transaction chain on the Genesis block.
3) All the branching due to multiple transactions arising from past single transactions shall be written using the unique ID at each step of the supply chain.
4) This process shall be considered till the consumer gets the finalized food product.
5) at each block of the blockchain, the difference between 9D sold product and the what product shall be calculated.
6) each block shall have a predefined limit of percentage profit or percentage loss.
7) At any point of time if the percentage profit/loss exceeds the cutoff, an alert will be generated to all the stakeholders backtracking the food supply chain.
8) If any kind of adulteration is found, the entire list of stakeholders Shall be printed using backtracking which can be used to make the stakeholders addressable for the mistakes.

The implementation this project shall be composed of two modules:

1) *Module 1: The Blockchain*

This module consists of the implementation part of the blockchain.
The baseline structure of the block is as follows:

a) *Hash*

- SHA256 on Data, PreviousHash and Timestamp

b) *PreviousHash*

- Hash of previous block in blockchain

c) *Data*

- Uid
- From
- To
- transactionValue
- percentProfit

d) *Timestamp:* This module is the foundation of the project. The data that we intend to track and store in the blockchain is in such a way that we can trace back the entire food chain from where the chain starts. Uid is the unique identifier given to the entire food chain. From and to define the stakeholders between which the transaction has taken place. Transaction value is the value at which the transaction of agricultural produce or processed food was transacted at. PercentProfit is the profit earned by "to" stakeholder. Proof of work consensus algorithm and validation is applied to each block to make the blockchain secure and free from fraud.

2) *Module 2 : Track Financials and Traceback Adulteration*

This module will help us track the financial frauds taking place in the food chain. Also if any adulteration occurs at any point of time in the food chain, backtracking shall be applied to trace back the adulteration in the food chain and hold the stakeholders accountable.
Each transaction will be Compared with a cutoff profit percent margin. If the profit percent exceeds the cutoff, an alert will be generated in all the peers softwares to notify of the financial exploitation taking place in the food chain. At any point in the blockchain, any stakeholder can raise a warning for adulteration for the given transaction. The software shall notify about the adulteration in all the transactions related to adulteration. A backtracking method should be applied in the blockchain to trace back all the transactions that prefix the adulterated transaction. This shall help interest back all the transactions and also put the stakeholders accountable for it.

Majorly, the use of blockchain in the peer-to-peer systems for all the stakeholders ensures the following

- Consensus algorithm make sure that majority approve the transaction taking plac
- No stakeholder can deny or contradict the transactions in the blockchain
- Financial exploitation is kept under control by alerting all the stakeholders when profit percentage is too high for any transaction
- If adultration occurs, backtracking all the transactions in the food chain is possible due to blockchain and previous hash stored in each block. All the stakeholders related can be held accountable for any adulteration occurring in the food chain.

a) Tools Used

Blockchain Functions:
Bouncy Castle Provider: Hashing Algorithm (SHA-256)
JSON: For storing blockchain Data

b) Algorithms

SHA-256
Proof of Work (PoW): no. of 0's in Hash Value

c) Languages

Java

d) Block Chain

The concept of blockchain tracers back to 1991, but was first predominantly used by Satoshi Nakamoto to build the famous currency Bitcoin in 2007. As a concept, blockchain is basically a chain of blocks or nodes. Each block stores some data and its own hash value.Hashing makes each block secure such that if any part of the data is changed the hash value you will let us know that the block is being tampered with. This provides security and prohibits data tampering within a block. Along with its own hash value, each block also stores the hash value of its predecessor in the chain. This leads to a formation of a long chain of blocks attached to each other through this previous hashing value storage. In its entirety this is the basic concept and foundation for a blockchain. but it can be noted that changing the entire blocks in the blockchain will be very easy if you go on changing and recalculating hash for each block. To avoid this, blockchain also uses one more concept called proof of work. Proof of work is basically a hashing algorithm that needs to be recalculated each and every time A block needs to be verified.The proof of work algorithm takes 10 minutes or above for each block thus making it very difficult and costly to tamper with the entire blockchain list. This prohibits data manipulation in the change and also secure source data tampering and blockchain tempering at any point of time. It can be noted that as the blockchain becomes longer and longer, the amount of time that is needed for calculating proof of work also goes on increasing. This crosses the big data concepts and is the reason why blockchain technology is very secure and reliable in cryptocurrency like Bitcoin ethereum excetra. It is also noted that a timestamp of the transaction can also be saved in the data value of the blockchain hence no one can invalidate any transaction that is present in the blockchain. All the updated nodes in the blockchain are sent to all the peers and the transaction is recalculated and validated at each node. This basically gives a consensus-like protocol which says that if 50% of the network agrees to a block then that is the valid block. This can also be seen that if the blocked Chain needs to be E tampered with, not only all the blocks need to be changed and proof of work needs to be calculated for each block, but also this exact thing needs to be done in at least 50% of the entire network. such a tempering is practically impossible to happen because of the shared processing power and cost it takes to do such a thing. Also tracing back the attacker would be very easy if one changes one block and the consensus is invalidated, the user might just be thrown out of the network to secure the entire blockchain.

e) Proof of work (PoW)

Proof of work is a concept in blockchain technology which is used as a consensus algorithm to reach a majority in the blockchain. The idea behind proof of work is that any machine that intends to add data into the blockchain should first show some work that has been done by the participant to prove that they are legitimate users. The algorithm is made such that only the legitimate users that are adding the new data without changing the existing data can get the work done in a reasonable amount of time.

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Any malicious user that tries to change the existing data will have to do an indefinite amount of work before they can change the data in the blockchain. the time taken in such a malicious attack shall be so so high that the amount of resources and time put into the Attack will be higher than what can benefit from. This basically makes the blockchain secure from hacks and external attacks.

A simplest form of proof-of-work can be in the following way. Hashing algorithms are a trapdoor function meaning they are Irreversible indefinite amount of time. This means that given the input finding out the hash value is very easy but given the hash value finding out the input is not possible. one of the proof of work can be in the following way. given the hash value find out the input prime number that generates the hash value. due to the trapdoor functionality of hashing functions we know that finding out the prime number when its hash value is given is very difficult. Hence such an algorithm can be used as a proof of concept.

Now here lies a little bit of a problem where an attacker with a high amount of resources can pre calculate all the hash values of prime numbers in the modulus range and can then use it as a look-up table to easily find out the prime number when the hash value is given. Here we can see that the calculations are dependent on Input and not on output hence input can be recalculated. to make it a little bit more difficult we can change the dependence of calculations from input to output. one another proof of work system that we can use is to find out the input that generates a specific number of zeros in the hash value. This is the exact functionality that is being used in our system.

IV. RESULTS

Creation of blockchain, validation of blockchain, retrieval of the data from the Stored file have been tested and are working correctly. The test variable here is the difficulty level of proof of work. As discussed earlier, the proof of work algorithm searches for the number of zeros in the hash value. The algorithm continues indefinitely until the input is found which gives the hash value that has a predefined number of zeros in the hash. The number of zeros in the hash can be considered as the difficulty level. getting successive and number of zeros in the hash values is very difficult and this increases exponentially with the number of zeros required. Here is a table that lists out the time taken to get the input that has a number of zeros in the hash.

TABLE II
NOTABLE RESEARCH AND THEIR CITATIIONS

No. of 0's in Hash (Difficulty)	Time Taken to solve (in ms)
1	1
2	2
3	2
4	23
5	725
6	2044
7	284693
8	246578
9	690786559

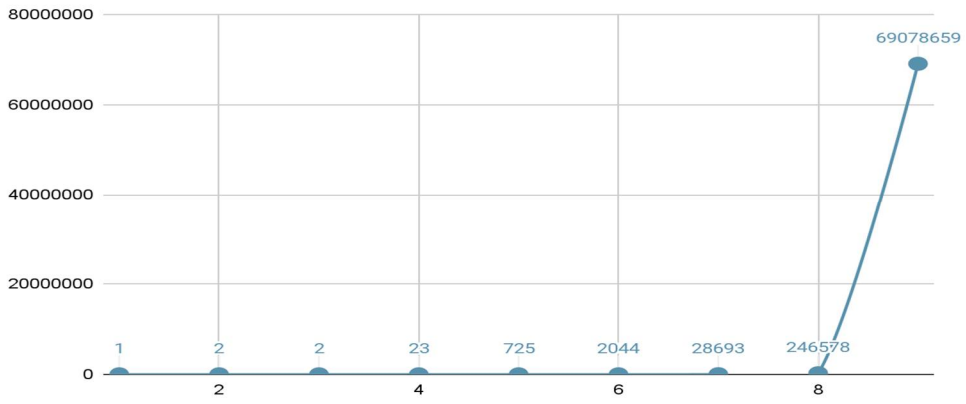


Fig. 2 Difficulty vs Time Taken(in ms)

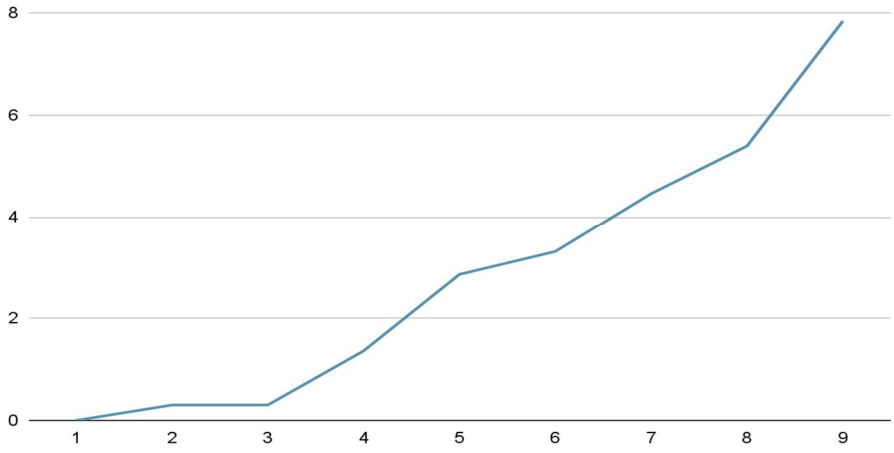


Fig. 3 Difficulty vs Log base 10 of Time Taken

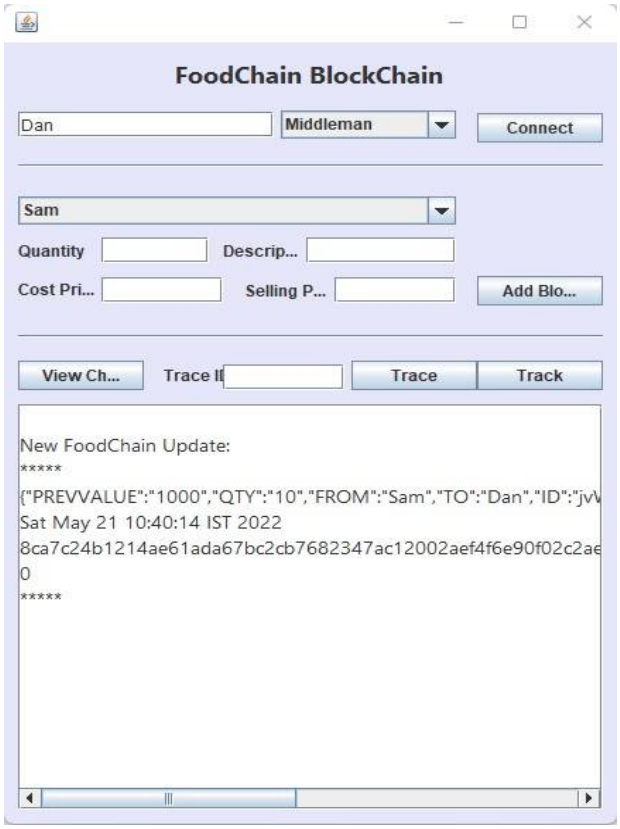


Fig. Screenshot of the Application

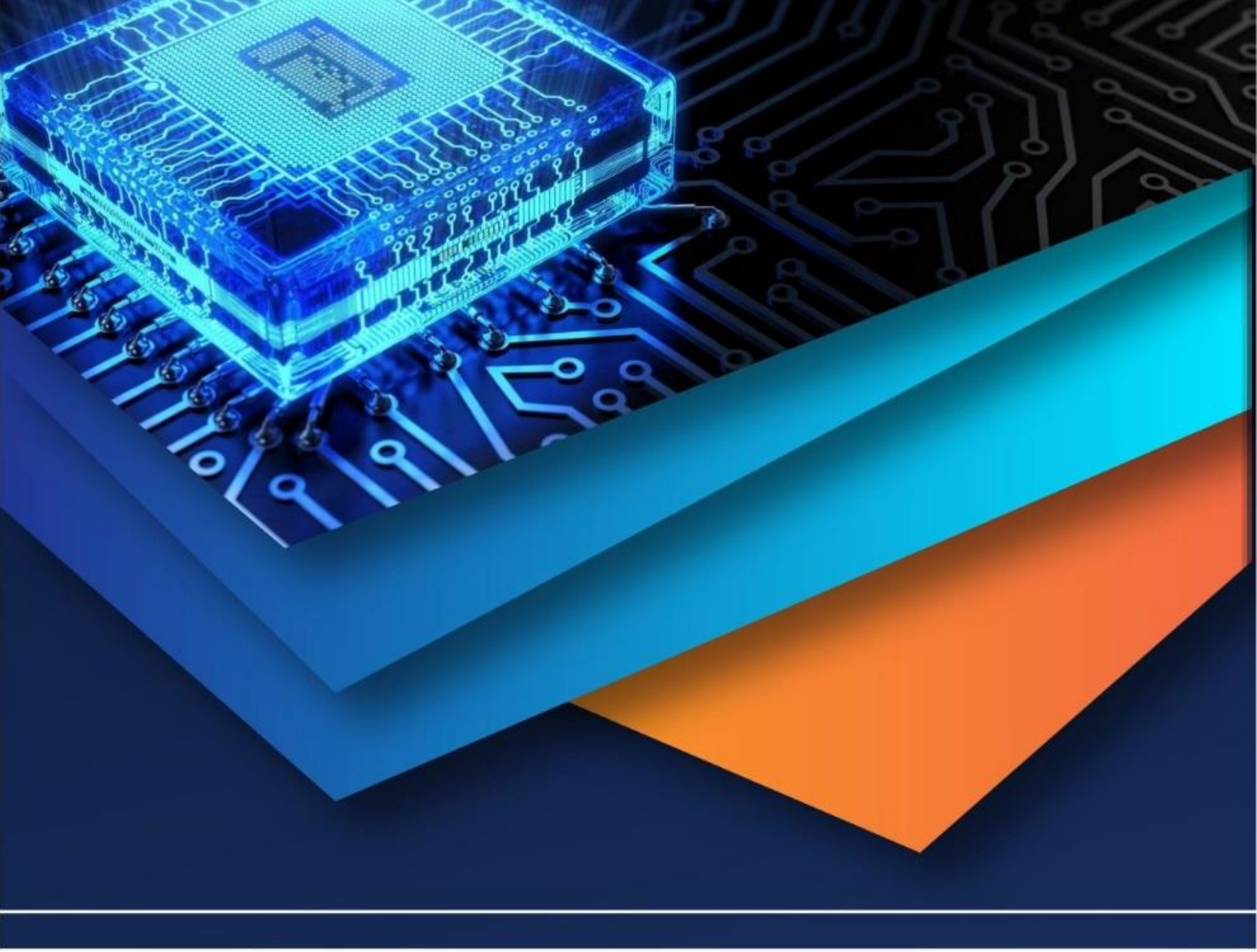
V. CONCLUSIONS

Blockchain Technology gives a very reliable and transparent way of storing data and sharing data within the pairs. There are very few loopholes in blockchain technology and the ability to attack the blockchain to change the data within the blocks is practically impossible due to strict hashing and proof of work algorithms applied in the blockchain. Hence blockchain can be used to trace the financial exploitations, frauds and backtracked adulteration in the food chain in the agricultural industry. This research project intends to understand the use of blockchain technology in the food chain in the agricultural industry and implement a novel approach to tackle financial Exploitation and adulteration.

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