PROJECT REPORT

Farmer Insurance Chain

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ABSTRACT

Agriculture being the major occupation carried out in India, the Government has deployed various farming and insurance schemes for the benefit of the farmers. Based on research it has been observed that only 50-55% of the total farmer population have taken up insurance or have the correct understanding and knowledge. The current research and technologies proposed and developed involve providing new farmers with knowledge about how to take up farming as an occupation and provide answers to the various farming related queries.Providing a smooth farming experience with all the required information to start an occupation in it is great, but there also needs to be an understanding on how they can save or protect the farm from any accident or a misfortune that may happen in future. This is where insurance for farmers come into picture and needs to be addressed to make it more aware among the masses. The current research does not mention the importance on farmer insurance and is a limitation.The system developed as a result of this research is analyzed conceptually to address the current system limitations and provide an insurance automated system.

1. Introduction

Agriculture is a big part of the economy of any country becauseit helps feed the entire population. It connects and commu- nicates with all of the related industries. If the agriculture base isstrong, it is generally regarded as a socially and politically stablesociety. Many modern farms make use of cutting-edge tech-nology and scientific and technological ideas.

The following are some of the reasons for food supply chain problems and processing environment challenges.

The maximization of the profits relies on some farmers' vegetables and fruits with chemicals. Chemical fertilizers, insecticides, and other compounds are used in several plantsand fruits.

As a result, pesticide residues in vegetables and fruits become excessive. It is a significant health risk.

Food gets contaminated with heavy metals. The irriga- tion water source of crops is polluted by the excessiveintrusion of heavy metal elements such as lead, tin, mercury,and zinc, which are dangerous to human health.

Food additives are used excessively in food processing. Some nefarious enterprises use excessive food additives, antibiotics, hormones, and harmful substances.

The following are some of the most common blockchainapplications.

(i) Agribusiness insurance.
(ii) Smart farming.
(iii) Traceability.
(iv) Land registration.
(v) Food supply chain.
(vi) Security and safety farms.
(vii) Agricultural product e-commerce.

As a formal definition, the blockchain is a distributedledger to share transactions or sensitive data acrossuntrusted multiple stockholders in a decentralized network. The data are recorded in a sequential chain of hash-linked blocks that facilitate the data distribution to be more manageable than other traditional data storage formats. Theblocks are verified and uploaded into the chain-like system by selected nodes via an agreed consensus protocol. This consensus mechanism allows all the parties to engage in themonitoring process when adding data flow. In addition, the duplicates of these data are stored in all involved nodes to ensure no tampering.

To make agricultural applications more efficient andreliable, we can divide blockchain applications into four categories. The first is the provenance of traceability and food authenticity. The second category is smart agriculturaldata management. The third category is trading finance in supply chain management. The last is the category of other information management systems [3].

In agriculture, collecting data is frequently prohibitivelyexpensive. The blockchain provides a dependable source oftruth about the state of crops, inventories, and contracts.Food provenance is tracked using blockchain technology,which aids in the creation of trustworthy food supply chainsand develops trust between producers and consumers. It alsoenables timely payments among stakeholders generated bydata changes when used conjointly with smart contracts [4].Many characteristics of the blockchain make it unique and promising for future industrial applications. For example,blockchain is decentralized, transparent, immutable, irre-versible, autonomous, open-source, ownership, provenance (authenticity and origin), and task automation.

Contract automation (smart contracting) eliminates the need for a traditional contract while improving security and lowering transaction costs. Smart contracts are designedwith rules and actions that applied to all parties participatingin the transaction [5].

E-agriculture, or smart farming, refers to building in- novative methods to use modern information and com- munication technologies (ICTs), such as the Internet ofThings (IoT), cloud computing, machine learning, big data, and blockchain, to move towards more feasible agricultural and farming practices. Blockchain technology in agriculture is gaining traction because of its ability to move away from the centralized approach that now governs the farm value chain. The new technologies have produced Agriculture 4.0or smart farming [6].

Smart contracts help manage the challenges in imple- menting the revenue sharing algorithm and improve pro- ductivity, transparency, security, traceability, and fullintegration between supply chain levels.

Smart contracts are considered a flexible type of plan-ning because they provide cost metrics that get used to accomplishing high productivity within plans for producing and delivering products in the context of current market restrictions and then executing the established programs [7].All innovation results from an attempt to solve a problem, and blockchain technology is no exception. After learning about the origins of blockchain technology, it is evident that blockchain solves a flaw in existing centralized agricultural systems.

At the security level, we can never eliminate vulnera- bility; it can only be decreased and lessened. When parties sought to establish an agreement, groups have always functioned as third-party lawmakers to reduce suspicion. One party expects fair goods, while the other hopes to re- ceive the negotiated cash. Even though the buyer and seller have no reason to trust one another, they complete the deal because they trust the third party. Blockchain claimed to overcome these issues by helping apps develop in a decentralized and safe way and ensuring some guaranteed level. One of the critical reasons for blockchain's widespread adoption was this. Implementing blockchain and smart contracts and profiting from their advantages is a big mo- tivation to improve the agricultural system model and makeit more secure.

On the blockchain, all transactions are securely recorded. The controller may use this technology with smart contracts and the Internet of Things to control the supply chain management, store farm data, and manage identity, among other things. On the blockchain, personal data are masked and need permission control to access them. In- formation gets stored over multiple computers (distributed ledger) rather than on a single server; this system makes it harder for hackers to alter data. By maintaining a track audit, blockchain can instantaneously trace commodities or goods, assisting in delivering proof and revealing weaknesses in any supply chain. Furthermore, smart contracts will automate transactions and enhance efficiency. Smart contracts elim- inate the dependence on human intervention and ignore the reliance on third parties.

In our architectural scheme, IoT will play a role of collecting the environmental data. Smart contracts will playthe role of data science analyzer, which means dealing with data for actionable insights, while blockchain records and validates data. This scheme uses algorithms created to govern interactions with various data segments. The next step of this system is to create a blockchain system auto- mated by smart contracts and make the correct predictions after analyzing the collected data. This project will guaranteethe enhancement of farm production. The application platform will allow all the participants on the network (providers, farmers, customers, and distributors) to visualize data and trace product growth. Blockchain validates data using a decentralized consensus algorithm and encryption, making it nearly hard to alter owing to the massive amount of computer power needed. As previously stated, block- chain's validated data are organized, comprehensive, and immutable.

When we talk about the tracked product, we discuss the collected environmental data in which the goods have grown. The network members will get all the growth hu- midity, temperature, light, and soil pH details. They have code that says "If *x* event occurs, perform *y* action." The participant will receive the updated data every period. When the customer knows all data about the product that he will buy, he will be satisfied with all this shared information andglad to be a part of this commercial deal. Also, when the farmer controls all the necessary conditions to grow the optimum quality, he will build the confidence to shar

information with customers and gain their trust. Another example of an advantage for the supply chain management provided by the scheme is allocating goods arrived andwhich container is in it. Blockchain allows tracking and storing information such as order receipts, product status, shipment details, and regulatory information to increase transparency and customer satisfaction.

Smart contracts are composed of codes that analyzecollected data and display to members if the sensor results are on the optimum values. These contracts help track the product supply chain by keeping eyes on product identifi- cation and detecting the member that holds the product. Furthermore, the block cannot store the data until it is verified and validated by control members, so the case in which an entity can be malicious is significantly minimized compared to other centralized systems. In general, the truth is that blockchain systems and smart contracts can perform middleman duties independently.

Concerning the prospective research gap and research challenge, we noticed that many researchers built a scheme that consists of a single blockchain that stores data about farms, entities, products, financial business, deals, and tradesall in one distributed ledger. We reckon that the data in our system need to be more structured. The research challenge isplacing data related to individuals into "the user block- chain," data describing products into "the product info blockchain," and data related to deals between entities into "the transaction blockchain."

Also, the relationship between entities builds on trust, and each participant knows their responsibilities and rights. On the other hand, we have seen that some researchers do not automate specific tasks, such as detecting environmentalsensor data without intervention. So after doing some studies, we have decided to work with smart contracts as a blockchain companion.

Generally speaking, the blockchain system aids by taking advantage of its solid security-protecting approach (simul- taneously dispatching the last version of data to all networkmembers). Since agricultural data are sensitive and essential,the blockchain helps to entirely transform how the infor- mation is seen by adding an end-to-end encrypted system tothe blocks. It is important to remember that distributed data guard against fraud and illegal behavior. Participants in the network get secured data, and their personal information is anonymized. Attackers cannot access or alter the data be- cause the information is not kept on a single server and the validated blocks have a very minimal possibility of being reversed.

Because blockchain employs a distributed ledger,transactions are recorded identically in many places withoutthe need for synchronization, and guaranteeing transpar- ency is another significant benefit (improve speed pro- cessing). Additionally, this method aids in data tracking for analysis and reveals weak links in any supply chain. Smart contracts automate transactions, speeding up processing time and minimizing human involvement. In this study, the smart contract helps analyze the values, verify environ-mental data, and identify the crops with optimal growth status.

In the following sections, we will discuss how we cancombine these technologies to create a robust scheme. Of course, the adoption of IoT is always advantageous since thedata collected from these sensors are more exact and in real time. All these elements are unexplored areas, limit the scope,and define the conceptual boundaries in our research field,

which will boost our chances of having a better research study. We will provide further comparisons between the proposed and past approaches. Previous work will be listedin the upcoming paragraphs for sure. Still, the main point weare trying to convey is that the smart contracts developed inour architecture are innovative and have the potential toobtain sensors' values automatically, such as the optimumtemperature, humidity, light composure, and soil pH values. The components of the smart contract's Solidity script are considered the source of the idea's novelty. Besides, decent data structure organization on the blockchain layer constantly improves data management. These details will guideus to generate new observations or insights based on prediction while incorporating other innovative technologies
like artificial intelligence.

1.1. Comparison between Existing Agricultural Schemes andthe Proposed Model. Figure 1 shows the difference betweenthe existing agriculture supply chain (using the centralizeddatabase), a standard blockchain-based agricultural supplychain, and the proposed blockchain-based agrarian architecture. The key reason we chose to work with blockchain andincorporate its features into our architecture was the absence of need for third parties. Additionally, the control over a decentralized ledger stays with the user rather than a centralized authority.

Another benefit of blockchain is that there are no data breaches and hacks. However, the scalability of a centralized system with a single server is limited.

Implementing a blockchain system protects data so it cannot be changed or erased. But the recorded data in the standard blockchain architecture are not well organized, andmany previous works did not use smart contracts, which facilitate some operations and tasks without the involvementof network participants.

The suggested model includes several blockchain ledgers that divide the data into user information, agri product information, and transaction information. Additionally, smart contracts are considered a significant factor in this model, which automate many tasks.

Most blockchain systems implement smart contracts provided by the Ethereum platform and its extension platform, Quorum: they compile using Solidity or Serpent into Ethereum virtual machine (EVM) bytecodes. Hyper- ledger Fabric and Sawtooth, the most active platforms in the Hyperledger family, use Golong, Java, Python, and Java- Script as the major programming languages for smart contract development [3].

1.2. Related Work. The only way to verify and validate transactions in the system is to use IoT devices that are physical consortium members. With the RAFT consensus

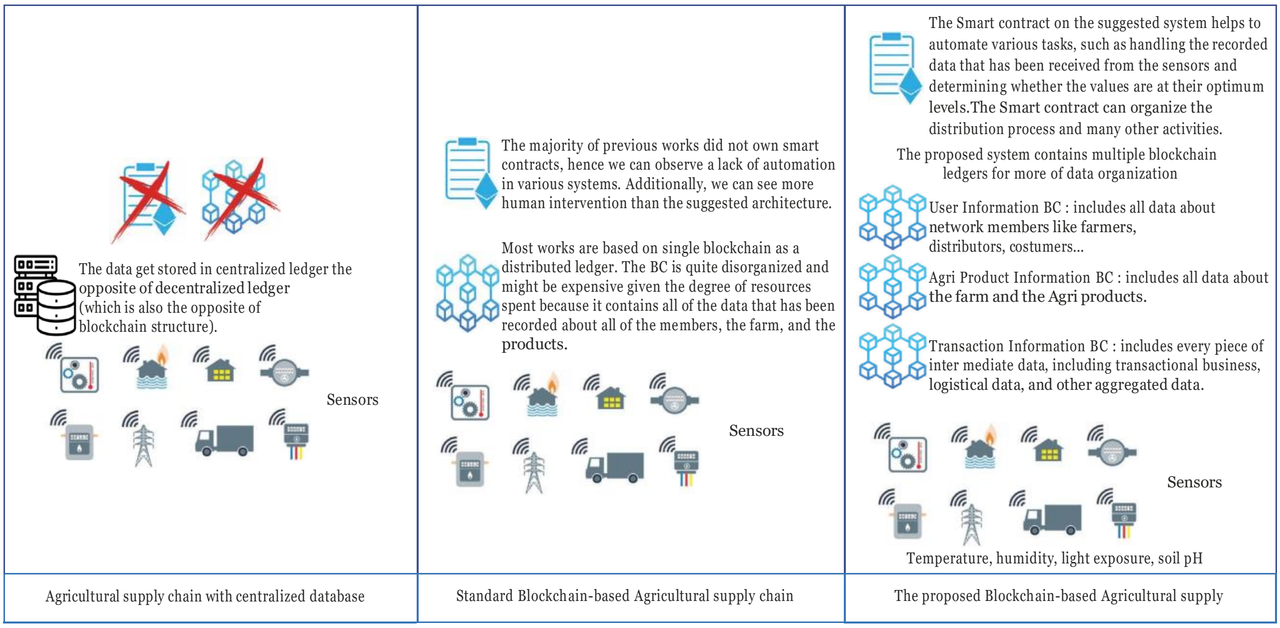

The data get stored in centralized ledger the opposite of decentralized ledger (which is also the opposite of blockchain structure).
Sensors
Agricultural supply chain with centralized database
The majority of previous works did not own smart contracts, hence we can observe a lack of automation in various systems. Additionally, we can see more human intervention than the suggested architecture.
Most works are based on single blockchain as a distributed ledger. The BC is quite disorganized and might be expensive given the degree of resources spent because it contains all of the data that has been recorded about all of the members, the farm, and the products.
Sensors
Standard Blockchain-based Agricultural supply chain
The Smart contract on the suggested system helps to automate various tasks, such as handling the recorded data that has been received from the sensors and determining whether the values are at their optimum levels.The Smart contract can organize the distribution process and many other activities.
The proposed system contains multiple blockchain ledgers for more of data organization
User Information BC : includes all data about network members like farmers, distributors, costumers...
Agri Product Information BC : includes all data about the farm and the Agri products.
Transaction Information BC : includes every piece of inter mediate data, including transactional business, logistical data, and other aggregated data.
Sensors
Temperature, humidity, light exposure, soil pH
The proposed Blockchain-based Agricultural supply

Figure 1: Comparison between existing agricultural schemes and the proposed model.

algorithm, the proposed blockchain platform becomes not only energy-efficient but also faster and scalable that can record thousands of confirmed transactions per second across multiple ledgers. Third, the blockchain with the RAFT consensus mechanism provides a transparent, secure, andtrusted platform for faster exchange of all types of servicesamong stakeholders. The RAFT consensus mechanism guarantees integrity if more than 50% of transacting nodesare honest. Several consensus algorithms are proposed forreaching a consensus among several action nodes, includingproof of work (PoW), proof of stake (PoS), practical Byz-antine fault tolerance (PBFT), and RAFT. The publicblockchain generally uses PoW and PoS, although they lackthe speed of confirmation. As a decision, our consensusmechanism decreases the use of the blockchain to connectvarious agri-based IoTdevices. The RAFTconsensus methodis more convenient to employ in a private blockchain [8]. “A secure fish farm platform based on blockchain for agriculture data integrity” research [9] mentioned that smartfarming necessitates scalable security. Therefore, variousstudies have focused on developing new paradigms based on
blockchains.

The technology of SkuChain focuses on establishing direct contacts while also increasing trust in the supplychain. More than half of blockchain discussions are around retail and agricultural input and output tracking.

We can get agriculture data from many sources, such assoil sensors, weather satellites, drones, and farm equipment.It can be saved in a distributed store using the blockchain with secure long-term agriculture progress.

The distributed ledger records all of the activities of the farm. It is tied to the data collected by agricultural sensors. Furthermore, smart contracts are used to automate agri-culture data processing, including outlier filtering, before generating records in the ledger. Smart contracts could activate and execute particular actions based on data recorded in the blockchain.

The blockchain has access control that determines who gets permission to reach network resources or perform actions on them.

The blockchain is a continuously expanding collection ofdocuments known as blocks. A block often contained the hash value of the preceding block, a timestamp, transaction data, and much other information. It is impossible to tamperwith the data without breaking the hash links. The block- chain network contains many peers, each of which has a smart contract.

A block must include signatures from a certain number of people. This technology eliminates the risk of data disclosure and guarantees that no unauthorized user can tamper with a transaction on the blockchain.

Blockchain functions are transaction verification, identity validation, and peer-to-peer communication. Also, some network services are available as web APIs, allowing external systems or client apps to connect.

The smart contract is distributed across a blockchain network in a single package. Once the contract is deployed, all of the smart contracts included inside it are available to applications.

The smart contract defines a collection of transactions. Participants in the blockchain network (for example, a farmer) or assets (anything of value) are used as resources (for example, water level data). The supported operations are CREATE, READ, UPDATE, and DELETE.

(i) The water level sensor can CREATE and Collect theWater Level transaction.

(ii) The farm owner can CREATE many transactions such as Predict Water Level, Energy Consumption, User

(iii) The water pump has access to ALL operations for the Control Water Pump transaction.

(iv) The farm owner and the farmer can READ many transactions such as Water Level History, PredictedWater Level History, Energy Consumption History,and Water Pump History.

The following research represents the article "Blockchain and smart contract for IoTenabled smart agriculture" [10]. It mentioned that seed storage, supply stores, producers, distributors, wholesalers, and retailers are the main actors in the system. In addition, the contract deployer is another actor here. The interaction method between the actors and the system is accomplished through several components. The sections below demonstrate the role of each actor.

(i) *Contract Owner*. The contract owner has more control over the system than anyone else. The owner enters the contract into the system and checks to see if the rule gets correctly implemented.

(ii) *Seed Storage*. Seed and other agricultural productsare stored in the seed storage.

(iii) *Supply Shops*. They collect and sell a significant quantity of seed, fertilizer, and other agricultural materials to growers.

(iv) *Producers*. The farmers are considered the most basic rung in production. They are in charge of alltasks relating to agricultural planting andharvesting.

(v) *Distributors*. Distributors are in charge of safely transporting crops from one location to another.

(vi) *Wholesalers*. Wholesalers buy a decent quantity ofcrops and agriproducts and resell them to retailers.

(vii) *Retailers*. Retailers buy commodities and productsfrom wholesalers and sell them to consumers on asmall scale in open markets.

(viii) *Consumers*. They are a large group of individuals that rely on agricultural products. They play a big part in the system by constantly creating demand.

FarMarketplace is a novel digital marketplace [6]. It fully exploits the advantages of blockchain capabilities by pro- posing smart contract templates between farmers, con- sumers, and deliverers. FarMarketplace is considered innovative in three aspects.

FarMarketplace offers three main smart contracts coded in Solidity programming language. The first smart contract is "atomContract.sol." In this contract, the user buys the contract.The funds were added to the balance. The buyer gets identified.After that, the buyer receives the object of the contract, and theseller receives the money.

The second smart contract is coded in Solidity pro-gramming language. This file creates the smart contracts, sets their value, and monitors their status. This file can also modify the accessibility from available to unavailable or vice versa. Some methods determine if the conditions are met and, as a result, generate an error.

The second smart contract is "ownable.sol."

The ownable contract has an owner address and providessimple authorization control functions. This system makes user permissions easier to implement. The ownable con- structor sets the original owner of the contract to the sender account. This file also can let the current owner transfer control of the smart contract to a new owner.

The article "Securing parked vehicle assisted fog com- puting with blockchain and optimal smart contract design" [11] mentioned that the blockchain provides complete se- curity for parked vehicle assisted fog computing (PVFC). Asa result, PVFChain, a specific blockchain system for com- putation offloading, is established to record and confirm crucial information about requesters and performers.

Without any third parties, the decentralized PVFC is builtby relying on a majority of consensus nodes. Smart contracts organize the posting of requests, the completion of workloads,the grading of tasks, and the distribution of rewards.

Any registered entity to PVFChain is controlled to follow the contact-based agreement via smart contract execution. Due to the inbuilt transparency and accountability of smart contracts, fraudulent requesters and performers are exposedcompletely. Accessible records regarding the activities of requesters are tamper-resistant because of data auditing. Finally, PVFChain protects against network vulnerabilities by supporting identity authentication, request validation,computation verification, and reward integrity.

The feasibility of PVFChain depends on the identifica- tion of critical network entities. Requester, performer, and miner are the three main network entities.

When a mobile car runs a compute-intensive application on the road, it sends a computing job to PVFChain. This previous operation triggers a smart contract. PVFChain system transmits a task to a responsible administrative agent.At the vehicular network edge, the agent organizes the offloading service. In the PVFC environment, the agent looks for a fog server near a parking lot and uses that to complete cooperative tasks.

There are various business platforms available nowadays. For example, Ethereum is a common platform that facilitates smart contracts on the blockchain. On the PVFChain, eachsmart contract has its address, allowing us to describe businesslogic for constraining network behaviors in offloading activities.

In summary, the operations of the smart contract are as follows:

Step 1. The requester sends a computing task containing task requirements and a deposit to PVFChain. After that, the assignment gets allocated to a particularized agent.

Step 2. Through the clients, performers can see the offloading requests and the work criteria.

Step 3. Some performers respond positively to the requests and upload basic task execution information with their .

Step 4. The agent is authorized to recognize and pick suitable performances based on prior knowledge. The agent also assigns various rewards for performers.

Step 5. The client of the requester offers attractivecompensation to the performers.

Step 6. The performers select a portion of the workloadto process based on the rewards offered, and the agent provides the necessary input data for task execution.

Step 7. The actors distribute computing resources to obtain output outcomes. The smart contract contains their identities, node types, a total of processing workloads, and output results.

Step 8. A specific transaction in the smart contract authorizes miners and analyzes the output results. The miners choose suitable third-party methods to present evaluation findings.

Step 9. The agent collects all the output results and aggregates them into a final result before sending it to the requester.

Step 10. Finally, the requester offers additional pay- ments. Qualified performers get promising prizes.

The article "Smart contract-based agricultural food supply chain traceability" [12] suggests that tracking and executing transactions in the agricultural food supply chain necessitates applying the Hyperledger Fabric to establish consortium chains and smart contracts called Chaincode.

The entire process of the agricultural food supply chain from farm to fork is as follows:

(i) *Agricultural Bureau.* It is an entity that keeps trackof farmers, seed information, plot information, andyield data to assure the accuracy of source data. Thedata are saved in IPFS, and the blockchain con- serves the hash value.

(ii) *Farmer.* He is in charge of sowing crops, utilizing sensors to monitor and record crop growth in the growing environment, such as water, air, sunlight, and soil quality. The farmer saves the information about the crop growth process in IPFS. Further- more, the farmer is responsible for generating smart contracts and storing IPFS data hashes.

(iii) *Processor.* The farmer gathers the crop and sells it to the processor, who transforms the raw crops into products for the final customer and records batch information, quantity, and other information in IPFS. The data hash is saved in the blockchain, andthe data label is created and put on the product package.

(iv) *Quality Supervision Bureau.* It is in charge of overseeing qualities and conducting mandatory inspections of manufacturing companies. All the tasks help respect regulations concerning stan- dardization and quality and penalize rule violators.

(v) *Distributor.* Before reaching the retailer, the fin- ished product may go through several tiers of distribution. The distributor is in charge of storing

and selling processed agricultural products to re- tailers in batches. Company information, product selling times, prices, and other data are kept in IPFS. The hash value is stored in the blockchain, just as it is for the quality supervision bureau, to ensure that the succeeding data are unchangeable.

(vi) *Retailer.* He purchases products from distributors and then sells them to consumers in modest amounts. IPFS stores on the blockchain some basic information about the retailer. For example, it stores the time of sale, the quantity sold, and the hash value.

(vii) *Consumers.* These are the people who buy and eat the finalized agricultural food, and they can get the complete supply chain information about it by scanning the barcode, RFID, or QR code on the product package, which makes tracking food easier.

The smart contracts interact with the blockchain par- ticipants. Our network participants and their objectives are listed in the "Blockchain-based soybean traceability in ag- ricultural supply chain" research [13].

(i) Seed company maintains local records and pro- duces seeds. These seeds get labeled by the EAN- UCC global standard.

(ii) Farmer purchases recognized seeds from seed companies, harvests the crop, and sets up the smartcontract. Data are also saved on the decentralized file system IPFS by the farmer.

(iii) Grain elevator: a grain elevator is an agricultural institution. These organizations decide the quality of the product by managing the sensing data and storage duration of the harvested crop.

(iv) Grain processor purchases grain from the elevator, refines it, removes foreign matter, and produces the finished product.

(v) Distributor is in charge of the product distribution procedure.

(vi) Retailer purchases traceable items from manufac- turers and sells them in small quantities toconsumers.

(vii) Customer is the person who uses the product and consumes it.

Any smart contract code can be handled using the Ethereum virtual machine (EVM). This EVM is in charge of comprehending every command code and ensuring that the smart contract is executed on all nodes.

The research employs Ganache as a local Ethereum testnetwork rather than the whole Ethereum network. Thepurpose.

Computing equipment like microcontroller systemsand cloud computing.

(i) Applications and libraries include mobile deviceapps, machine-to-machine communication, API, and a blockchain web app.

The agricultural zone is equipped with an IoT controller, sensors, and cameras. The controller will encrypt the environmental (sensing) data before sending them to the blockchain network. At this point, the controller will use machine-to-machine communication to connect with theblockchain network [14].

Precise measurement is critical in agriculture. The soil type and the climate influence the monitored metrics on a field. The following are a few of them [15]:

(i) *Air Temperature and Humidity*. Seed germination gets relative to the optimum temperature because the phases of biochemical mechanisms depend on enzyme activation and hydration. Also, humidity gets defined as the water vapor pressure in moist air.

(ii) *Soil Temperature and Humidity*. As a carbon storage tank, the soil is a considerable component in irri- gation scheduling. The watering period is deter- mined by the driblet irrigation technologyemployed or the techniques of deep wells.

(iii) The fundamental goal of this type of irrigation is toimprove plant water quality standards. Sunlight andhumidity have a significant impact on soil tem-perature. The temperature of the soil is generally higher than that of the air.

(iv) *Evapotranspiration*. It is a component of the hy- drologic process that is the most elemental. Con- sumptive usage includes plant transpiration and water evaporation from the soil.

AgriOnBlock [16] ensures non-repudiation and con- firms the authenticity by encrypting and decrypting the transaction with the private key and public key of a cryp-tography mechanism like RSA.

(1) When a retailer wishes to get a product from the warehouse, it communicates with AgriOnBlock and the bank, specifying the identity product, the item code, the quantity, and the rate per unit.

(2) The retailer has adequate funds, and its credentials are verified. The required amount gets transferred from the account of the retailer to AgriOnBlock.

(3) The bank informs AgriOnBlock that the payment transaction was successful.

(4) Once AgriOnBlock receives the proof of payment from the bank, it directly notifies the warehouse to transfer the requested item in the stated amount to the retailer.

(5) The transaction gets recorded in the AgriOnBlock.

The steps for the interactions between some agriculturalsupply chain entities are as follows:

(1) The farmer lodges an insurance claim to AgriOnBlock.

(2) AgriOnBlock delivers the information to the in- surance carrier when it gets verified.

(3) The insurance company sends the claim to a surveyorfor physical inspection.

(4) The surveyor physically visits the site to do thesurvey.

(5) The surveyor submits a report to the insurance company, accompanied by the amount of the in- surance claim for payment.

(6) The insurance company notifies the bank to reim- burse the farmer after obtaining the report from surveyor.

(7) The bank pays the farmer.

(8) The insurance company informs AgriOnBlock of thetransaction.

Smart contract algorithm for AgriOnBlock supply chainmanagement:

Step 1. If the farmer does not have the ready harvest, stay on step 1; otherwise, proceed to step 2.

Step 2. If the farmer prepares a crop invoice and sends itto the retailer, the request to pick up the crop gets forwarded to the shipping company.

Step 3. If the retailer confirms the invoice received fromthe farmer, it will transmit a confirmation to the shipping company (and proceed to phase 4); otherwise,it will go to the error step (error code = 1).

Step 4. The shipping company picks up the produce from the farmer and delivers it to the retailer and then updates the transaction on the AgriOnBlock after re- ceiving the invoice from the farmer and confirmation from the retailer.

Step 5. If the transaction updated by the shipping company on AgriOnBlock is verified, the smart con- tract between the retailer and the farmer gets executed to inform the bank to transfer the amount from the retailer to the farmer, and the transaction gets updated on AgriOnBlock; otherwise, go to error step (errorcode = 2).

Step 6. The retailer creates a crop invoice and sends it tothe distributor.

Step 7. If the distributor confirms the invoice sent by theretailer, he submits a request to the shipping company,and then the transaction gets added to the AgriOn- Block. Otherwise, you will be directed to the error step(error code = 3).

Step 8. If the shipping company validates the bill receivedfrom the distributor, the shipping company produces thecrop from the retailer to the distributor and updates the transaction on the AgriOnBlock. If the shipping com- pany does not validate the invoice received from the distributor, go to the error step (error code = 4).

Step 9. Go to step 11.

Step 10. Error: if the error code is 1, the retailer informsthe farmer of the reasons for refusing to accept the invoice. If the problem code is 2, the retailer and the farmer notify about a failed bank transaction. If the problem number is 3, the distributor informs the re- tailer of the reasons for not accepting the invoice. Fi- nally, if the problem code is 4, the shipping company contacts the distributor about the reasons for not ap- proving the invoice.

Step 11. Stop.

"Blockchain and edge computing technology enabling organic agricultural supply chain: a framework solution to trust crisis" research proposed that the physical layer, edge data layer, smart contract layer, cloud/blockchain layer, anduser layer are the five levels that make up the concept. This viewpoint is from the standpoint of data flow [17].

(i) *Physical Layer*. A smart contract gets placed in this layer, consisting of numerous sensors, controllers, and IoT devices. These devices are either encapsu- lated with the smart contract address of the client or discovered by a discovery service. Furthermore,numerous wireless protocols such as Wi-Fi, Zigbee,or LoRa are commonly used in agricultural farms.

(ii) *Edge Data Layer*. The edge nodes make up this layer for deploying containerized microservices, data infrastructure, IoT devices, and QoS control. The edge data layer takes data from the physical layer. It analyzes, compresses, transforms, and splits the data into local and cloud ones. The data rights or the identification of the data creator is initially com- pleted by this layer. As a result, this layer enables off-chain verification of tracking data from a cloud-based blockchain. Local servers are in charge of storing off-chain data. This testing overcomes the blockchain implementation problem, privacy,transmission bandwidth, energy usage, and latency,to name a few.

(iii) *Smart Contract Layer*. This layer is responsible for assembling a group of smart contracts. It enables effective, distributed, and heavily automated OASCworkflows. Smart law contracts, decentralized au- tonomous organizations (DAO), and application logic contracts are included in this tier of smart contracts, which go beyond the transfer of simple currency values. The law contracts specify strict legal remedies to prevent contracting parties from car- rying out their obligations. DAO is a blockchain- based community that can design a list of norms expressed in smart contract code. Each participant should respect these rules and have the right to seek recourse if the program gets stopped.

(iv) *Cloud/Blockchain Layer*. This layer combines a cloud storage repository with a blockchain-like ledger that supports three types of blockchains: public, alliance,and private. This layer takes advantage of the alliancechain to include all stakeholders in OASCs. This typeof chain combines public and private chains. Cloud/ blockchain layer introduces an InterPlanetary File System (IPFS) and BigchainDB. IPFS is new content-addressable storage. On each computer, the same filehas the same name, and any change in the data file causes the modification in the file name. Due to data storage constraints, the process only keeps the hash value of the file content in the cloud blockchain, andthe file itself gets saved at the edge. This layer also utilized BigchainDB, a data storage and search engine, to suit the query specifications of files.

(v) *User Layer*. The user layer is the main gateway for anyone interested in tracking organic products or maintaining OASCs. The blockchain ecosystem gets linked to this layer via the blockchain bridge, whichresembles an Ethereum bridge Metamask and isavailable as a browser add-on. Furthermore, this layer offers a variety of APIs.

The article "Blockchain for Internet of Things: a survey" [18] mentioned that the Internet of Things (IoT) is a sig- nificant part of this revolutionary transformation by bridging the gap between the physical industrial system and the cyber-physical system (CPS). Because of its increased connectivity, safety, protection, dependability, and flexibil- ity, blockchain is essentially the ideal companion to IoT.

IoT devices are capable to interact with one another without the assistance of a reliable third party. Smart contracts can help us reach this flexibility. Contract pro- visions included in smart contracts, in particular, will be done automatically in a specific circumstance.

Many IoT devices make up the perception layer, such as sensors, QR code tags, RFID tags, smart meters, actuators, regulators, and other wireless tools. These gadgets can perceive and gather information about the zone.

IoT gateways, Wi-Fi access points, small base stations, and macro-base stations may link with various wirelesssensors, RFIDs, regulators, and other tags to establish an industrial network at the communication layer. Different communication protocols facilitate the connection, in- cluding Bluetooth, low-power wireless personal area net- work (LoW-PAN), near-field communication, and wireless highway addressable remote transducers.

Concerning traceability, a timestamp gets appended to each transaction stored on the blockchain. After examining the blockchain data with matching timestamps, users may quickly check and track the provenance of the last data.

Integrating IoT systems with blockchain technologies (such as smart contracts) can strengthen the network's se- curity by continuously refreshing IoT device firmware to fix security flaws. However, developing smart contracts is dy- namic and involves several agreement cycles. Meanwhile, it also involves several groups, including stakeholders, regu- lators, and software developers.

Software-defined networking (SDN) technology can deliver distributed IoT with adaptability. Networks may now be more agile and flexible to serve different application and performance needs thanks to SDN technology and network function visualization (NFV). The mixture of blockchain and

SDN can eliminate the drawbacks. However, various con- ditions in the hybrid environment are required to enhance and deploy network and computer assets.

One of China's famous supply chain architectures im- plements both RFID and blockchain. Data on the food supply chain's tracing are maintained by this approach. The research demonstrates how blockchain might sweeten food quality by making traceability of goods available. Also, situations showed that customers could follow the entire product manufacturing process if blockchain formed in the food supply chain.

The research "The performance evaluation of blockchain-based security and privacy systems for the Internet of Things: a tutorial" [19] discussed security levels and how we can implement blockchain systems and IoT in one architecture. The validator gathers new transactions, checks that they adhere to the rules, and then adds them to the block to prepare it. After several durations, the network participants can no longer change the information stored in the blocks. When a transaction appears in a validated block, it is regarded as proved. Each block has a unique hash code stored in it as its identification.

The application of blockchain technology in IoT agri-culture concentrates on three aspects:

(i) Helping farmers track down the source of their fresh produce.

(ii) Enabling peer-to-peer agro-based transactions via smart contracts.

(iii) Ensuring the integrity of agriculture data by boosting sales of fresh vegetables and addressing the problem of environmental pollution.

Given the overall mobility and group-based behavior, IoT devices in blockchain applications furnish meaningful confidentiality.

The four levels that made the software-defined network (SDN) architectures and network function virtualization (NFV) are the perception layer, data plane, virtualization and control plane, and blockchain layer.

Data collection from the environment completes at the perception layer. Data flow to and from the perception layer via IoT bridges is achieved by the data plane. Resources are typically assigned to controllers using the virtualization and control plane. The blockchain layer's duties include data storage, broadcasting transactions, and P2P network man- agement via a consensus mechanism.

We can explain some keywords that are required to be defined.

Ganache is a private Ethereum blockchain that executes scripts and tests, builds smart contracts, and creates apps. The Ganache testbed is a blockchain testing platform designed to execute data trades and assess the charges of smart contracts. Both desktop program and command-line tool are available.

A decentralized framework called Ethereum Geth uses the Ethereum protocol to operate smart contracts. The private blockchain network and smart contract deployment are carried out via the Geth Ethereum client using the Go programming language. In addition, for calculating the time required to pack data into the blockchain system, Ethereum Geth is employed.

The Rinkeby Ethereum testnet is a development and testing condition for Ethereum, a proof-of-authority con- sensus-based platform. The efficacy of the blockchain-based fog computing system is assessed using this testnet.

For Ethereum, Truffle is a development and testing environment that includes an asset workflow and network management for deploying public and private networks.

Remix Ethereum IDE is a browser-based compiler that helps users construct Ethereum contracts in the Solidity programming language and inspect transactions.

The article "Security challenges and opportunities for smart contracts in Internet of Things: a survey" [20] says that the smart contract system is still not advanced or reliable. Distributed autonomous organizations (also known as DAO), the largest blockchain initiative to be crowdfunded with assets worth roughly USD 60 million, are responsible for the most well-known smart contract accident. The DAO was hijacked in 2016, causing a significant loss because of a recursive call that the attackers had cruelly changed its smart contract. Given that research on blockchain-based IoT has been gaining steam recently, it is critical to investigate the potential threat as soon as attainable.

Another frequent security issue with smart contracts is programming vulnerabilities, particularly with a new lan- guage like Solidity. Hackers would likely use these flaws to target IoT and smart contract systems.

For instance, the unchecked call/send functions return a Boolean result to represent the success or failure of the call. The transaction performing these functions will not get rolled back if the external call fails, an error will arise, and there will not be a rollback if the return value has not yet been under complete verification. As a result, the attacker gains illegal entry into the smart contract's protected operations.

When Solidity types are used for direct calls, the calling party must define the interface of the recipient and cast it to the recipient's address.

As an integer variable may only represent a specific range of values, the EVM provides a fixed-size data format for integers.

Every Ethereum smart contract has an address object and can contact other addresses. The address of the ac- count that initially made the global variable tx.origin returns the query or transaction. This variable fully tra- verses the call stack. Utilizing this variable to approve IoT users is prohibited as it increases the risk of phishing attacks.

Through constructors in smart contracts, programmers may initialize contract objects. However, since the con-structor's name differs from the contract's name and is a public type, anybody may call the absent constructor due toits vulnerability. Furthermore, constructors get often used when initializing the contract to specify the administrator's address, the number of tokens, and other details. As a result,several parts of the IoTinfrastructure, such as network accessand token control, will be essentially destroyed.

Many owners' interests have been gravely impacted by the abovementioned problems, particularly in modern IoT setups. Thankfully, other academics are now looking at waysto address these problems. They looked for solutions such asfixing block timestamps' dependence, the inherently vul- nerable particularities, and security audits for programming vulnerabilities (using SCaaS, for example, a smart contract audit engine via signature matching and machine learning algorithms).

Smart contract encryption is a brilliant concept to ensure the privacy and security of the private data used in smart contracts. For IoT service providers and customers, the transaction details of the trade entities, the contract code, and the blockchain processing mechanism are precious. Therefore, a more dependable and cost-effective IoT systemis predicted in the real world due to the adoption of privacy- preserving smart contracts. This kind of security is achieved via various encryption mechanisms, including TEEs.

Adopting appropriate communication protocols is a valuable element in increasing the effectiveness of datatransmission for sporadic IoT networks. Named data net- working (NDN) is a new form of network design that in- cludes useful features.

Because of its unique properties like data immutability and transparency, blockchain can accomplish tasks to make clinical trials traceable and increase public confidence in anopen and equitable process, including all stakeholders. The smart contract safely automates these clinical trial processes while ensuring traceability and preventing a probability of reconstruction. The viability of the intended solution de- pends on a proof of concept of Hyperledger Fabric in clinical management research for numerous clinical studies. This model [21] is a Hyperledger Fabric type of blockchain with permissions, smart contracts, and good securityperformances.

Clinical trials produce sizable clinical research data to establish novel medications, devices, and medical or surgical procedures. Investigators take vital signs, variations in symptoms, and side effects in the study of all these recordeddata. In general, evaluating the data quality is a difficult taskand keeping the data quality at an acceptable level needs knowledge about the business and data modeling.

Many stakeholders are certified with blockchain tech- nology certification to ensure secure data transformation across many parties. Without a third party, clinical trial procedures are automated using a smart contract.

Numerous clinical trial-related service scenarios are demonstrated to show how the smart contract can manage tasks such as medical data gathering and audit queries. UsingHyperledger Fabric, a proof of concept shows how well the suggested solution works by carrying out the connectedprocesses to clinical trials among various organizations for various clinical trials. Additionally, a web-based applicationlets users communicate with the blockchain platform.

The model's architecture includes three layers: the physical layer, which contains all the necessary equipment, the medical pillbox, and blood analysis tools. This layer is connected to the service layer, composed of the blockchain network and its services such as smart contracts, consensusalgorithms, distributed ledger, and certificate authority. The ledger maintains replicated and shared data across the wholeplatform. The smart contract defines the business logic concerning all operations of clinical trials. The last layer is the application layer, which manages devices, eCRF, and users and deals with audit queries.

All transactions are generally available to apps after the smart contract launches and configures the network. Remarkably, the network administrator can initiate or pause the network and its functions. By calling the relevant transaction, it can manage a subject's profile. Additionally, the smart contract provides a specific rule list to determine whether or not a user is permitted to access or alter networkresources.

The experiment starts utilizing ten clients in a two-channel network of 8 organizations and 12 endorser peer nodes using the simulation program Hyperledger Caliper. The ordering service is in solo mode, and the block size setsto 10 transactions per block, creating a new block every250 ms.

Though it includes the medical area, this model is the closest research to my architecture. A multi-blockchain system with smart contracts and a physical layer consists ofthe tools required to collect priceless data, such as pillboxes, blood pressure monitors, and airflow sensors. This medical research and our research share many similarities. However,while our research focuses on agriculture, the other is in themedical field.

According to Hang et al.'s [22] research results, thethroughput, latency, number of transactions, and scalabilitywere some of the indicators used to analyze HyperledgerFabric's efficiency. The increased transaction has a consid-erable influence on network performance, notably latency. However, the throughput closes on zero as the network hitsits capacity. The authors tested the effectiveness of Hyper-ledger Fabric in terms of transaction throughput and net-work latency using various scenarios. Based on the network configurations, performance constraints vary somewhat ateach level. In these cases, the effects of factors like batch-timeout, batch size, and the number of peers are examined.Node.js is the programming language utilized to develop this blockchain, with smart contract implementations and amaximum of 5 clients or network participants. The blockcontains a maximum of 10 transactions, and its frequency is
a maximum of 250 ms.

This study introduces a unique fuzzy logic-based transaction traffic management method that helps boost blockchain speed. The model automatically carries out various operations on transactions received following cur- rent network circumstances; the fuzzy controller gets em- bedded in the smart contract. Without the involvement of a third party, the fuzzy-based transaction traffic controller in the smart contract may autonomously manage the traffic flow following the observed network circumstances.

The system architecture comprises the Hyperledger Fabric network, the admin, a blockchain adapter, a benchmark database, and a transaction traffic measurement analyzer. The distributed ledger and the smart contract get duplicated by network. The administrator can set up network files and benchmarks for performance analysis. A network configu- ration file summarizes the tested system and the conditions for connecting to the network.

A benchmark configuration file defines the user-speci- fied test files and the performance benchmark workload. Theclient where the workload occurs transmits transactions to the blockchain adapter, receiving them and sending in- structions to start the blockchain. By calling the smart contract functions, many clients can send transactions to thenetwork and receive replies to those transactions. The benchmark findings are stored in the benchmark DB by the transaction traffic measurement analyzer once it has read predetermined statistics. The fuzzy controller modifies the transaction approval rate by evaluating the acceptance rate, transaction throughput, and transaction delay.

Both transaction throughput and latency are the fuzzi- fier's input parameters. The inference engine assesses rules.The acceptance rate is transformed into non-fuzzy values bythe defuzzifier. The transaction control module obtains the output value, which then modifies the transaction accep- tance rate. The procedure gets repeated, allowing the Fabricnetwork to keep a proper degree of transaction processing capabilities dynamically. Transaction throughput and transaction latency are specified as the fuzzy variables for membership functions on the approach, and the acceptance rate is evaluated as "low," "acceptable," and "high."

The network model of Kumar et al.'s [23] research has eight core elements. Trusted authority, IoT devices, un- manned aerial vehicles, intrusion detection systems, cloud servers, InterPlanetary File Systems, smart contracts, and blockchain networks are these eight elements.

Before installation, the trusted authority must register IoT devices, unmanned aerial vehicles, and smart contracts.Using the established session keys, the authentication and key management phase of the Internet of Things (IoT) begins with mutual authentication and key agreement be- tween two IoT devices, between an IoT device and any as- sociated unmanned aerial vehicle, and between associated unmanned aerial vehicles and the cloud server.

The safe contact between the involved entities is maintained throughout this phase. The IoT device installed in each flying zone has the potential to extract agricultural values. Unmanned aerial vehicles (UAVs) are connected to each flying area to gather data from IoT devices. The cloud server saves transmitted transactions. In further detail, everycloud server mines valid transactions using smart contracts.This process keeps them in IPFS and maintains the returnedtransaction hash in the global blockchain network.

Each miner packs the IPFS hashes of the validated transactions into the current block while generating the block hash and Merkle root for the next block.

This model has specific verification procedures to guardagainst different kinds of threats. The attackers impersonate areal user by creating a temporary identification and a partial private key. However, a session-based technique confirms each device's identification. Access rights are given if all credentials match; connections are also promptly terminated.As a result, this strategy guards against spoofing attacks.The attackers may be insiders and have access to all credentials, including timestamps, pseudo-identities, and IoTdevice identification. However, the model can only grant access following session-based entity verification. Thus, themethod avoids insider attacks by not allowing access withoutauthorization.

With the strikes of man-in-the-middle (MITM) through unsecured channels and communications, the attacker may be able to obtain information about IoT devices. Attackers may provide information to UAVs, so they can carry out specific tasks. The UAVs, however, verify the session and look up the timestamp. As a result, the attacker is unable to conduct the MITM threat.

Fertilizers are crucial in smart agriculture by improving profit and decreasing waste. This paper [24] discussed the research difficulties of monitoring and managing farming land by enhancing crop yield and lowering resource, energy, fertilizer, and human interaction wastage. Information from the agricultural field is gathered using the multi-modal sensor. IoT-based agricultural systems assist in minimizing human contact and developing new valuable methods.

Any farmer may join the blockchain network without permission, a type of permission-less programmable blockchain, and they can carry out numerous transactions ina database. Different users connect to knowledge support systems through an intelligent interface device. Data about the land environment is gathered from various sensors and sent to the database server in the cloud environment. The MYSQL cloud database stores the acquired data. Data are compiled by the system at multiple intervals and sent to a cloud database. The machine learning algorithm creates knowledge patterns.

Every edge node in the network has a unique identity on the Hyperledger blockchain. The member service provider (MSP), which issues cryptographic certificates using a public key primitive, issues certificates to every network partici- pant. The user of the network receives a login and password. The user gets enrollment and transaction certificates to send transactions. In this approach, the chain code includes the business logic that establishes the state of the transaction. The ledger states that matching bock numbers get stored in the state database. Hyperledger offers a secure, scalable, andadaptable blockchain technology for agricultural knowledgesystems.

2. The Research

All old concepts are in service of the suggested theoretical architecture (see Figure 2). It is a multi-layer design, which is the cause why it will be easier to control. The Internet of Things (IoT) layer is the first. It consists of essential sensorslike humidity, temperature, pressure, acceleration, and othervariables connected to ARDUINO boards. Bluetooth or a wireless network is used to communicate between the de- vices. The Arduino features will provide us with data, which will be exploited in the subsequent layers. The first layer cansupply us with reliable environmental data.

The blockchain layer contains three particular block- chains, and the agri-product information blockchain is the

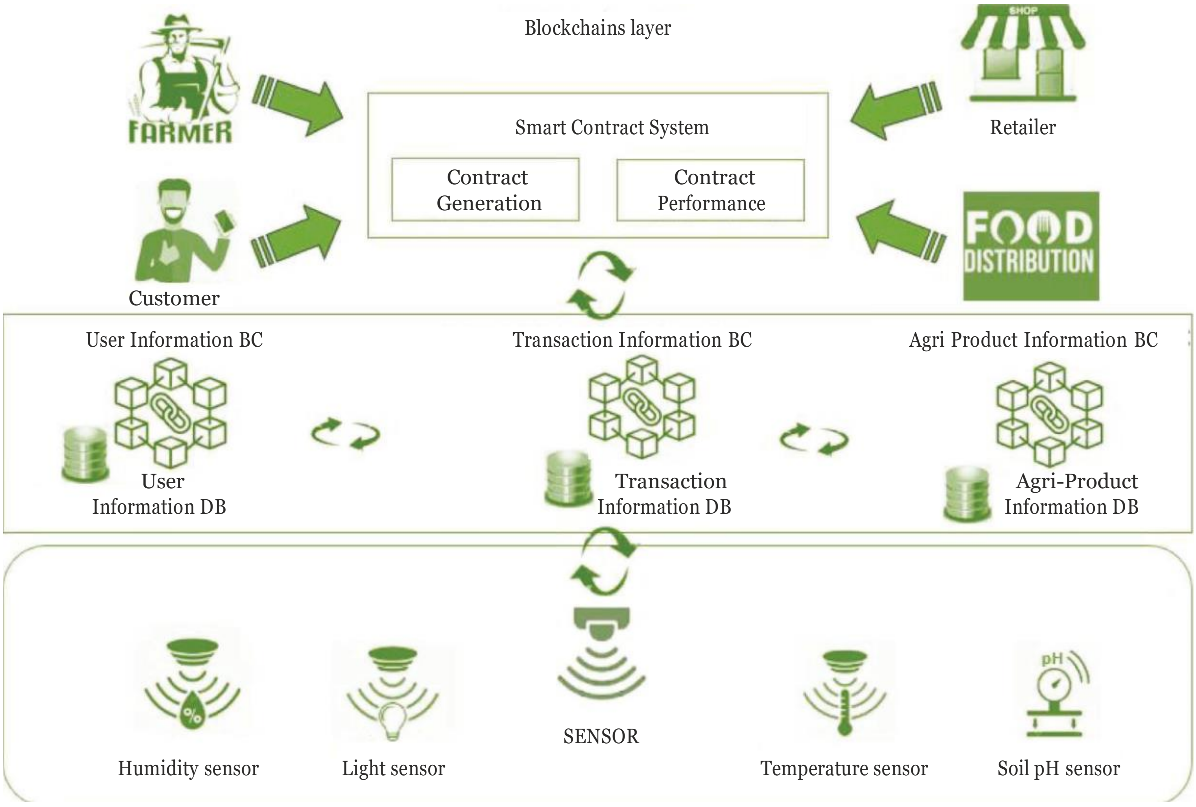


Figure 2: The proposed smart contract and blockchain architecture.

first. The user information blockchain is the second one. It has all the information about the network participants.

The transaction information blockchain is the last one onthe list. It holds a wealth of information, including user personal information, intermediate information, transac- tions, logistics, and agricultural product data. Smart con- tracts are used in this paradigm. Those automated contracts use the highest level of data encryption currently available inthe security industry. As a result, it will confirm the quality of the decision and guarantee clarity and effective communi- cation between entities .

Many sides will attempt to check the average transaction fees because the whole system comprises a multi-blockchain system. But let us see the other meaning of the blockchain model. The suggested architecture concurrently distributes secure data to all network participants. It is regarded as significant advantage that can increase the efficacy agri- cultural system.

The block will be full of transactions containing recorded data, and we will get multiple verified transactions at once. Combining numerous transactions into a single block each period is cost and space-efficient. So, batching allows for reducing per-transaction fees by aggregating various transactions into one. Following this protocol benefits you and keeps the fees low across the board for everyone. We canuse cryptocurrencies for frequent transfers across platforms if we want to add crypto money to our model. Their transaction fees are virtually nothing, for example, Ripple orLitecoin, because generally, cryptocurrencies are con- structed for lowering or eliminating fees.

The research does not focus on cryptocurrencies or transaction fees because the goal of our blockchain is just storing and transmitting data simultaneously to members, and that is all. But, if it is obligatory to mention some info, inthis case, everything on Ethereum's transaction fees was based on "gas," and the payment system will adopt the Ethereum payment process based on the calculated proce- dure. In 2021, the average bitcoin fees were between 2 and 5dollars. The average ETH transaction fee ranges from 2 to 7dollars or 0.00056 to 0.002 ETH.

The block size is crucial because it can significantly impact the speed and capacity of the network. After dis- covering some related research, the average block size needed in our model over 24 hours is between 0.75 and 1.25megabytes. The average transactions per block required in our model over 24 hours are between 1200 and 2200. The average number of payments per block needed to get seen inour model over 24 hours is between 2500 and 5500.

The members of this system are farmers, providers, distributors, retailers, clients, and controllers that help as a processing node for validating transactions, for example, to administrate the data provided by sensors and check if data (temperature, humidity, light exposure, and soil pH) are reasonable. There is no problem with hardware devices. Controllers can check the data traceability and the ware- house stock and quantity.

The class diagram in the Unified Modeling Language (UML) (see Figure 3) explains the structures, classes, at- tributes, methods, and relationships between objects to provide extra information about our model. Class user storesinformation about the network's participants, including farmers, distributors, and customers. The members who are on the blockchain network can visualize the database as wellas place orders for the products they desire. The sensors sendenvironmental information to ProductStatus, providingvalues and conditions to determine whether they are at their optimum level or not. These products belong to a unique category or sub-category. We added a class named Order- Details since the order class has a lot of data.

This use case diagram (see Figure 4) represents the actors in the system model. It displays the context and require- ments of our system. It functions as an outsider's perspectiveon a system that defines how users engage with its services. The farmer, distributor, and customer types of users are described in the figure. For example, farmers may provide a product that persuades a consumer to place an order for it. Distributors transported the goods from the farms to the consumer. The user can view a wide range of information on crop growth conditions using the soil pH, humidity, tem- perature, and light exposure sensors.

The food supply chain can be used to monitor a productfrom its raw material (e.g., tomato) on the farm to thefinished product (e.g., tomato sauce) on the shelf in the retailstore. This solution depends on many Solidity files. The firstfile contains Farmer Struct (Struct types are used to rep- resent an organized structure). This structure is composed ofthe ID and the name of the farmer. The second struct is the expected yields which contain the location of the land, the corps, the amount, the estimated price, and the expiration date. The deal struct is the third one, containing the terms, the amount, and the addresses of both the farmer and the customer. This contract can control farmers, manage their yields, organize deals, and recharge wallets. The farmer doesnot need to wait for a bank loan or other types of financing toget started. The consumers could provide the fund with zero interest. Furthermore, the farmers are not susceptible to lengthy and complicated bank financing procedures.

The food supply chain is controlled by the second file,
which contains three Solidity structs. The first is the goods quality report, which includes the address of the inspector, the quantity, the sample size, and any remarks about the goods. The processor report is the second struct, containing the notes, shipment data, and the received quality report. The last struct is the retailer report, which comprises the name of products, the raw material, remarks, the manu- factured date, the quantity produced, and the processor report received earlier. Companies can use the system to track unsafe products back to their source and discoverwhere they got dispersed. These advantages can save lives and money by preventing diseases. In addition, no one can tamper with the details of the quality reports (which get stored on the blockchain network) for their gain. The historyof some products can get tracked in real time from their inception to their current state. Consumers may obtain high-quality items at lower prices because they are sponsoring thecrops from the start. Consumers in the low-income categorycan fund crops according to their requirements and avoid market volatility in product costs. There is no need for vast farmlands. Even small-scale and family farmers can sell their products and make more money.

On the distributed public ledger, farmers can list their prospective crops. Consumers can look over the infor- mation and assess the credibility of the farmers based on previous cultivation and supply. This system establishes a transparent and tamper-proof digital market platform for farm products. As a result, the contract can be reached between the farmer and the customer, allowing the consumer to support particular crops or fields and acquire the production or a profit percentage of its market value. Based on previous agricultural production experiences, a ranking system gets adopted to enhance farmer and consumer trust. Eventually, the system will create a decentralized agro-market where farmers can raise funds for production while also having clients buy their pro- duce. Alternatively, customers can secure quality products at a lower cost by investing in crops early. Customers and farmers will benefit from establishing a trusting atmo- sphere for future collaboration. Farmers will make the most money from their produce, and the investors (consumers) will be able to feed their families high-quality food.

Next, there is the ownable contract, which has an owner
address. It provides sample authorization control. It makes user permissions easier to implement. The OWNABLE constructor sets the sender as the OWNER (the user who owes the product). The existing owner can also transfer the ownership of his contract to a new owner under this con- tract. The migration file facilitates the distribution of con- tracts to the network and serves as a staging area for your deployment activities. They get developed with the notion that your deployment requirements will evolve simulta- neously with the blockchain evolution.

Additionally, we can embrace the product delivery file and drop it on our architecture. The food delivery file is a smart contract for a decentralized food delivery service.

The system uses some features of Solidity code, such asthe unsigned integer UINT, which corresponds to the product ID and cannot have a negative value. The mapping isused to organize the order of products. The contract allows for the creation of products and the option of receiving them. Various functions check the contents of the smart contract, which the client will review and trigger if it is correct. Only customers will be able to inspect it, and only customers will queue outside to obtain the number of products. The contract adds or removes traces from a product and calculates a total of product traces for statisticalpurposes. The system also manages and controls tempera- ture, retrieves an array of temperatures, and returns thenumber of traced places.

We must not overlook the contract that entails self-
monitoring the humidity, temperature, soil Ph, and light exposure. Also, if these environmental data are beyond the threshold, below the threshold, or ideal, this file detects violations and triggers alarms.

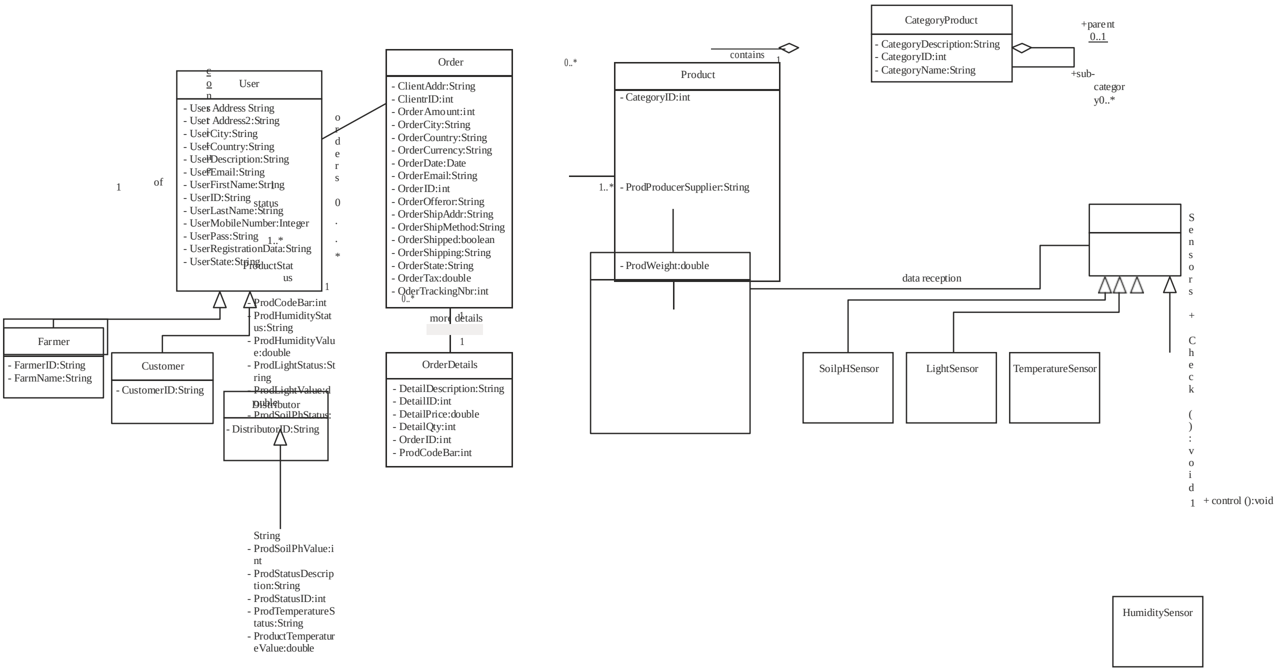


Figure 3: The class diagram of the proposed model.

The next step is upgrading the model to Ethereum 2.0, anupdate to the present Ethereum blockchain. It intends to improve the Ethereum network's speed, effectiveness, and sustainability by boosting the number of transactions. When compared to the prior version, it features several significantstructural transformations. "Proof of stake" and "sharding" are these effective modifications.

Validators, rather than miners, are used in the proof ofstake consensus method. Their primary function is topropose new blocks and offer computer power, storage, and bandwidth for transaction validation. Validators are paid in ETH regularly (deposit contract of 32 ETH to validators). Sharding is the process of breaking up a single block- chain into numerous shards. As a result, the network be-comes more solid since a single validator does not need to
handle the entire architecture.

The consensus process type is the main difference be- tween Ethereum 2.0 and its predecessor. Ethereum 2.0 employs a proof of stake (PoS) method. In contrast, Ethereum utilizes a proof of work (a power procedure in which miners decode complicated mathematical challenges using high processor quality and computer equipment).

Because Ethereum 2.0 will use fragment chains, it can process up to 10,000 transactions per second, whereas Ethereum can only handle 30.

Because the cryptographic approach is more straight- forward in Ethereum 2.0, it consumes significantly less energy. Furthermore, because of its effectiveness, the im- provement is projected to lower transaction fees inside the network, allowing for smaller transactions.

Agricultural production is influenced by various ex- ternal elements such as climate and harvest quality. The system links all of these participants with the end pur-chasers, allowing anyone to intercommunicate in the profits while ensuring that customers get their healthy crops. Ethereum 2.0 can improve supply chain transpar- ency and assist producers and customers in eliminating inefficient workflow. Validators can provide a perfectenvironment from the farm to the market. As a result, the goods' transaction costs will be decreased. The proof of stake can easily locate and track a product from a local store. This mechanism can also determine the farm that provided a crop as well as the date of harvest. The sharding process in Ethereum 2.0 can allow us to maximize theblockchain organization level by classifying user infor- mation from product information. The mechanism did not design validators in Ethereum 2.0 to resolve mathematical problems to validate transactions; instead, they must check data integrity.

A technical stack, sometimes referred to as a technologyinfrastructure or solutions stack, is currently crucial for creating scalable, maintainable applications. A technology stack is a collection of technologies layered on top of each other to develop any application. The technology stack in- fluences the sort of apps you may design, the degree of customization you can make, and the resources you require to build your application.

Proof of concept (PoC) is an essential component of every software project since they reduce possible risks and demonstrate the project's perspective.

Proof of concept should be the foundation of everysoftware development process since it has several benefits for projects. PoC takes care of everything, from reducing failurerisks to evaluating the possibility of scalability. To improvethe overall research, we have collected all the advantages ofthis procedure.

Risk minimization is by far a proof of concept's most significant benefit. The development team analyzes potential problems before beginning the procedure.

It is just as crucial to plan your scaling approach as it is torelease a top-notch product. In the long term, you need to know how to build your solution technically and commercially.

During a seed round, supporting the idea with concrete evidence of its potential is essential. Nobody pays for ab- stract ideas.

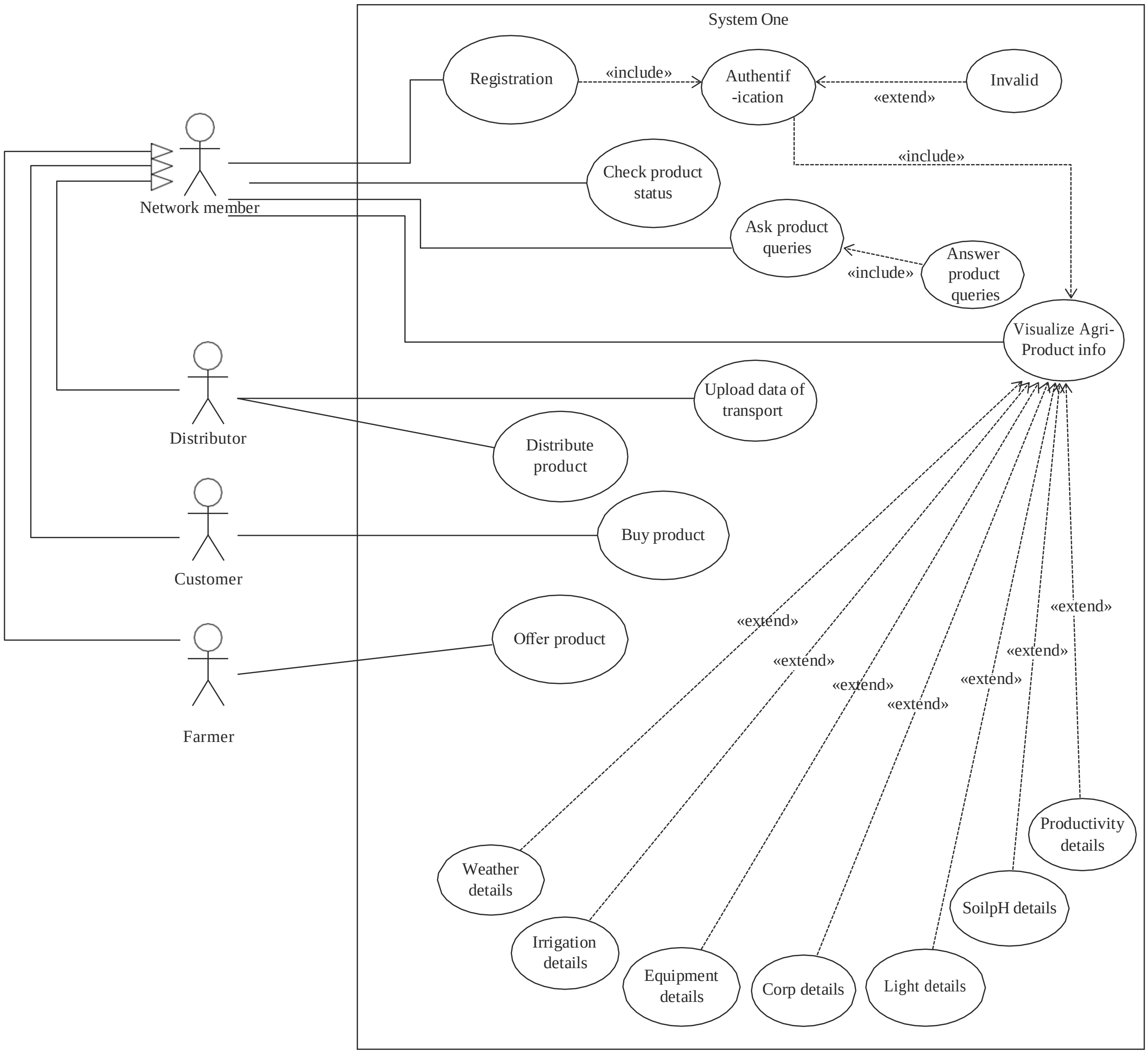


Figure 4: Use case diagram of the proposed model.

Building a PoC to test concepts in actual settings and obtain early feedback involves selecting the right technologystack and creating the architecture.

Figure 5 shows the technology stack of the proposed model.

The physical or infrastructure layer assists in gathering environmental data, such as soil pH, temperature, humidity, and light exposure measurements. We also have nodes, which are network members. A node is any device that has permission to access blockchain network.

Blockchain, as a concept, organizes data into user data, agricultural product data, and transaction data. Blockchains employ consensus methods to make sure the nodes reach anagreement. It is a fantastic procedure to increase the net- work's efficiency by introducing a new degree of depend- ability and achieving information security.

Large portions of the model are at the level of smart contracts. The middleman got just eliminated. You will nothave to worry about trust issues since there are standards protecting everyone's legal rights. Since everything gets computerized, higher authorities cannot have any impact, and the procedure is quite open.

The Kaleido interface serves as a functional testingplatform. It assists in facilitating access to the decentralizedledger. The users receive great help from this layer. Thisplatform enables access to all data. Peer-to-peer servernetworks allow users to connect to the blockchain network. We have selected the blockchain network and its tools/ services. The system software, database, server, and frameworks comprise most of the backend or server-side technology stack. These technologies are appropriate for our planned research. For the automation of various functions, we also have the opportunity of dealing with
smart contracts.

The front end of choice for most online apps stays thesame. The research will use a cutting-edge web application

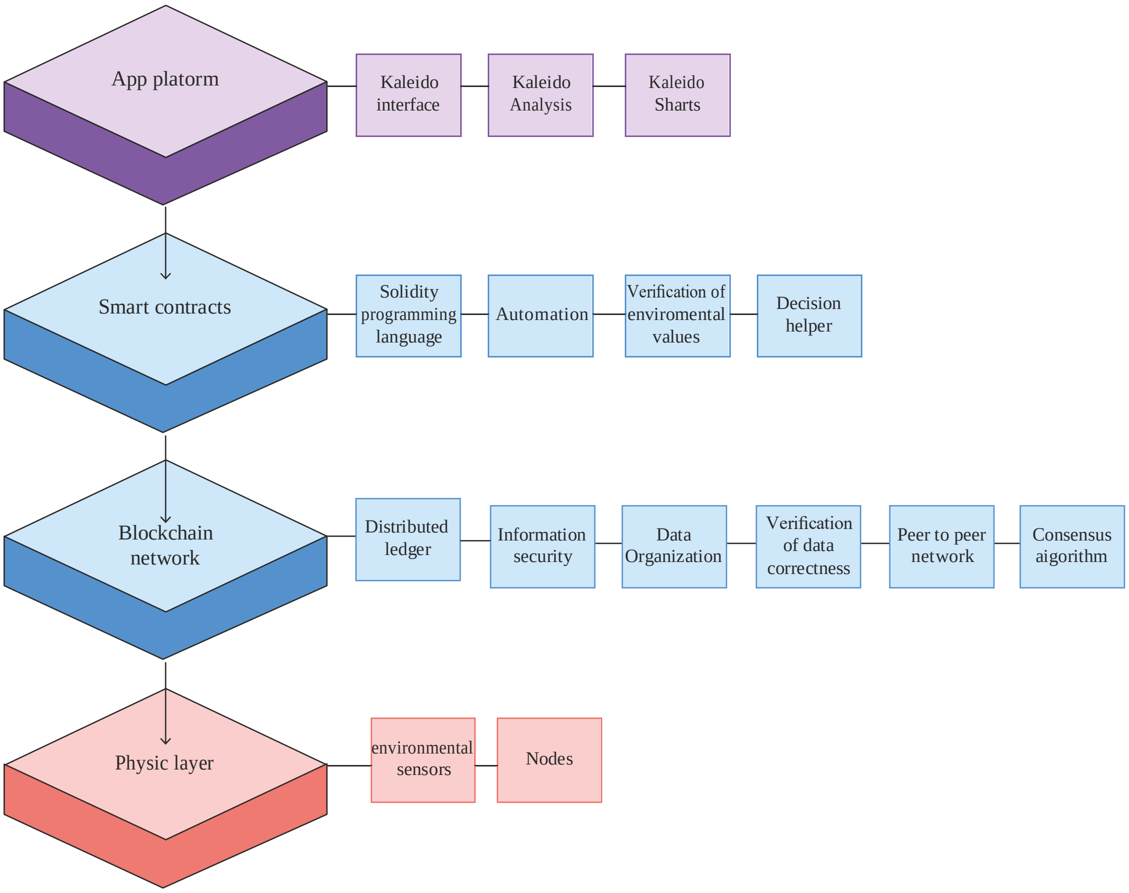


Figure 5: The technical stack of the proposed model.

built on the foundations of HTML, CSS, JavaScript, and TypeScript to deliver additional functionalities.

Programming languages handle the crucial business logicrequired by the applications. It is necessary to utilize the Solidity programming language and create source code thatwill automate various functions, such as identifying the cir-cumstances of crop growth. However, no technology can provide complete 100% security. The blockchain network consistently adheres to best practices to guarantee the highestdata and transaction protection level and reduce risks.

Future testing will focus on the new Web 3.0 blockchaintechnology stack, which differs from earlier iterations. However, transitioning from client-server architecture to a decentralized web will not be radical. The changes are sig- nificant and distinct.

Web 3.0 blockchain technology stacks are still devel- oping and maturing step by step. Even though they are safer,they are often a little bit slower. As a result, the transition would initially include building a partially decentralizednetwork before going decentralized.

3. Testing and Analysis

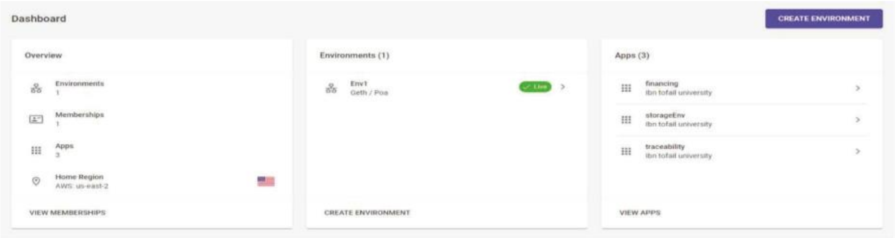
The figures depict the tested blockchain system. The tested architecture contains one environment, one member, andthree smart contract script codes (finance, storage envi-ronment, and traceability).

Figure 6 depicts the dashboard system, which allows theuser to learn about the testing environment. Among these data, we can find information about network participants like the membership name, the membership ID, the primarycontact e-mail, and the joining date.

The KALEIDO organization issues a membership cer- tificate with a common name and a serial code. In this situation, the dashboard shows a list of applications directlyconnecting to our blockchain system, like our smart contractscript codes.

Figure 7 shows the current condition of the blockchain system, such as the creation date, block height, network participants, release version, and protocol utilized (Geth/ Poa). We established two nodes (node 1 and node 2) for testing, and one of them is inserted by smart contract codes.There is also the node that has the name system monitor. These nodes have all got started.

The details of the block node injected with the smart contract script are shown in Figure 8. Among these details, we can find the node name (node 1), the node ID, the node size (small), the owner, the status (started or paused), and the AWS region because we have used the Amazon Web Services, along with the date it was formed and the date it was last modified



Dashboard

Overview

Environments
1

Memberships
1

Apps
3

Home Region
AWS: us-east-2

Environments (1)

Env1
Geth / Poa
✓ Live

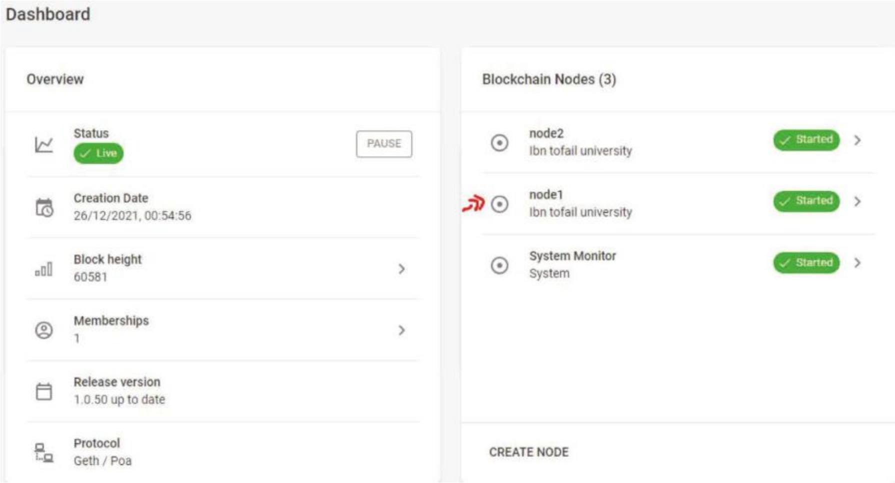
Apps (3)

financing
Ibn tofail university

storageEnv
Ibn tofail university

traceability
Ibn tofail university

Figure 6: Characteristics of the testing environment.



Dashboard

Overview

Status
✓ Live

Creation Date
26/12/2021, 00:54:56

Block height
60581

Memberships
1

Release version
1.0.50 up to date

Protocol
Geth / Poa

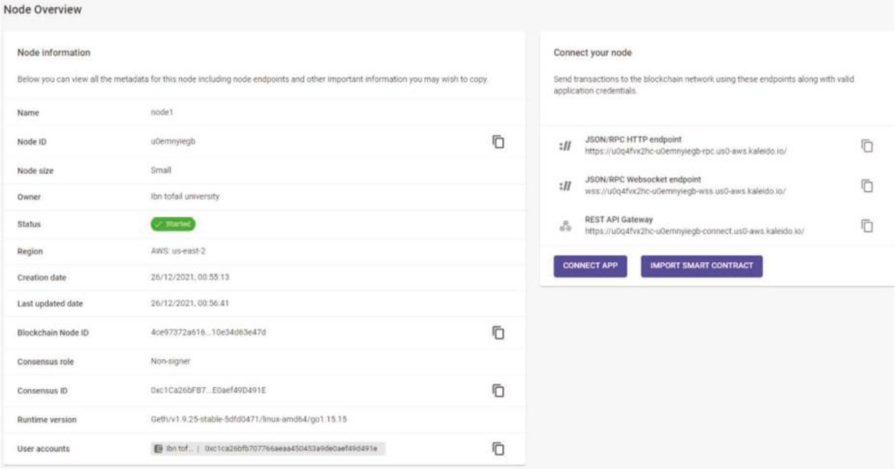
Blockchain Nodes (3)

node2
Ibn tofail university
✓ Started

node1
Ibn tofail university
✓ Started

System Monitor
System
✓ Started

Figure 7: Implementing the smart contracts on node 1.



Node Overview

Node information

Below you can view all the metadata for this node including node endpoints and other important information you may wish to copy.

Name	node1
Node ID	u0emnyiegb
Node size	Small
Owner	Ibn tofail university
Status	✓ Started
Region	AWS: us-east-2
Creation date	26/12/2021, 00:55:13
Last updated date	26/12/2021, 00:56:41
Blockchain Node ID	4ce97372a616...10e34d63e47d
Consensus role	Non-signer
Consensus ID	0xc1Ca26bFB7...E0aef49D491E
Runtime version	Geth/v1.9.25-stable-5dfd0471/linux-amd64/go1.15.15
User accounts	Ibn tof... | 0xc1ca26bfb707766aeaa450453a9de0aef49d491e

Connect your node

Send transactions to the blockchain network using these endpoints along with valid application credentials.

JSON/RPC HTTP endpoint
https://u0q4fvx2hc-u0emnyiegb-rpc.us0-aws.kaleido.io/

JSON/RPC Websocket endpoint
wss://u0q4fvx2hc-u0emnyiegb-wss.us0-aws.kaleido.io/

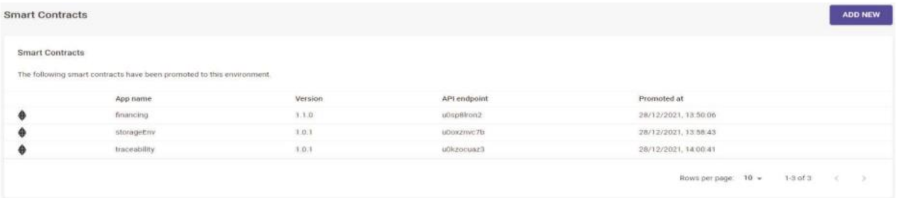
REST API Gateway
https://u0q4fvx2hc-u0emnyiegb-connect.us0-aws.kaleido.io/

Figure 8: The metadata of node 1.

The details include

(i) The blockchain node ID.
(ii) The consensus role (non-signer).
(iii) The consensus ID.
(iv) The runtime version.
(v) The user accounts.

In general, the figure represents all of the metadata fornode 1.



Smart Contracts

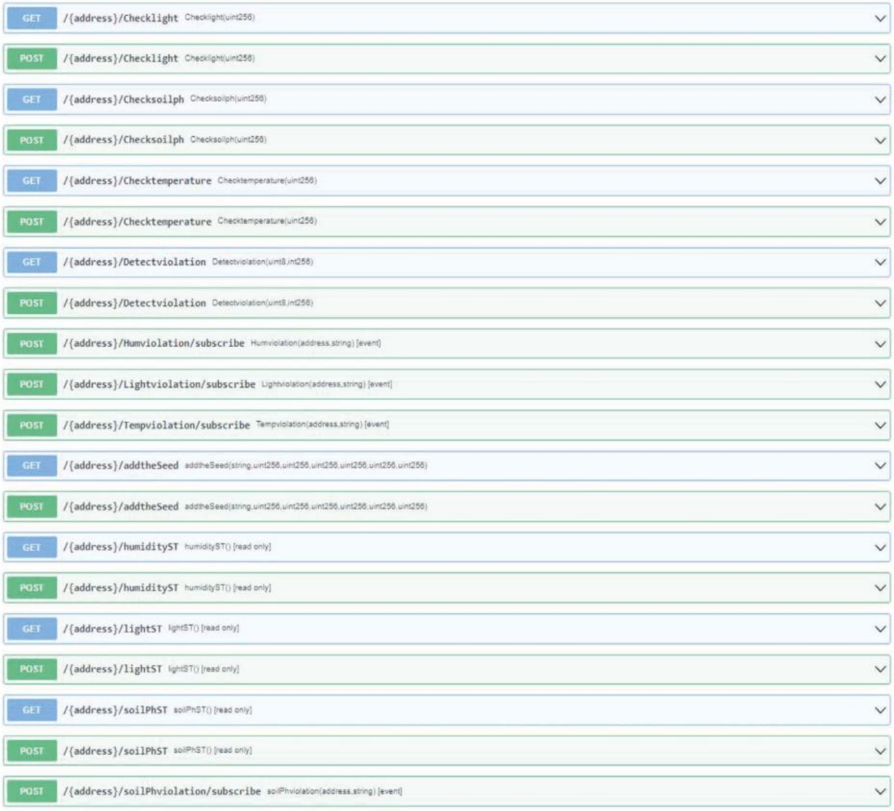
Smart Contracts

The following smart contracts have been promoted to this environment.

	App name	Version	API endpoint	Promoted at
◆	financing	1.1.0	u0sp8lron2	28/12/2021, 13:50:06
◆	storageEnv	1.0.1	u0oxznvc7b	28/12/2021, 13:58:43
◆	traceability	1.0.1	u0kzocuaz3	28/12/2021, 14:00:41

Rows per page: 10 ▾ 1-3 of 3 ‹ ›

Figure 9: The blockchain includes smart contracts.



GET /{address}/Checklight Checklight(uint256)

POST /{address}/Checklight Checklight(uint256)

GET /{address}/Checksoilph Checksoilph(uint256)

POST /{address}/Checksoilph Checksoilph(uint256)

GET /{address}/Checktemperature Checktemperature(uint256)

POST /{address}/Checktemperature Checktemperature(uint256)

GET /{address}/Detectviolation Detectviolation(uint8,int256)

POST /{address}/Detectviolation Detectviolation(uint8,int256)

POST /{address}/Humviolation/subscribe Humviolation(address,string) [event]

POST /{address}/Lightviolation/subscribe Lightviolation(address,string) [event]

POST /{address}/Tempviolation/subscribe Tempviolation(address,string) [event]

GET /{address}/addtheSeed addtheSeed(string,uint256,uint256,uint256,uint256,uint256,uint256)

POST /{address}/addtheSeed addtheSeed(string,uint256,uint256,uint256,uint256,uint256,uint256)

GET /{address}/humidityST humidityST() [read only]

POST /{address}/humidityST humidityST() [read only]

GET /{address}/lightST lightST() [read only]

POST /{address}/lightST lightST() [read only]

GET /{address}/soilPhST soilPhST() [read only]

POST /{address}/soilPhST soilPhST() [read only]

POST /{address}/soilPhviolation/subscribe soilPhviolation(address,string) [event]

Figure 10: Some of the functionalities of the smart contract.

In addition, the script code displays the current state of all these factors and the variety of additional features. This section is concerned with creating the best possible envi-ronment for seeds and products at farms and warehouses.The quantity of resources required to run these script codes defines their complexity. Time and memory con-straints are given special attention. These processes should take the same time on a particular system regardless of the input size. Another resource that gets used is the number of arithmetic operations.

These graphs (see Figure 11) illustrate that injecting smart contract code has a minor impact on the resources. The memory used by the smart contracts was just about 150 megabytes. In addition, the smart contracts only utilized roughly 40 megabytes of disk space. These numbers boost efficiency speed and have no negative impact on the system,computer nodes, or RAM.

Figure 12 depicts several successful block node trans- actions. These findings indicate that smart contracts might get used on a sensor dataset in the future (temperature, light,humidity, and soil pH).

The system is divided into three major categories. The first one is distribution and traceability, which encompasses all aspects of tracking and tracing a product from start to finish. The second category is finance, which involves all aspects of financial transactions. Finally, storage is the third category, which covers all violation management and reg- ulates the environmental data of the farm and the warehouse.

After employing IoT devices to insert product infor- mation into the system, the associated authority can verify the real-time temperature, humidity, soil pH, and light exposure conditions. The contract self-checks data to keep

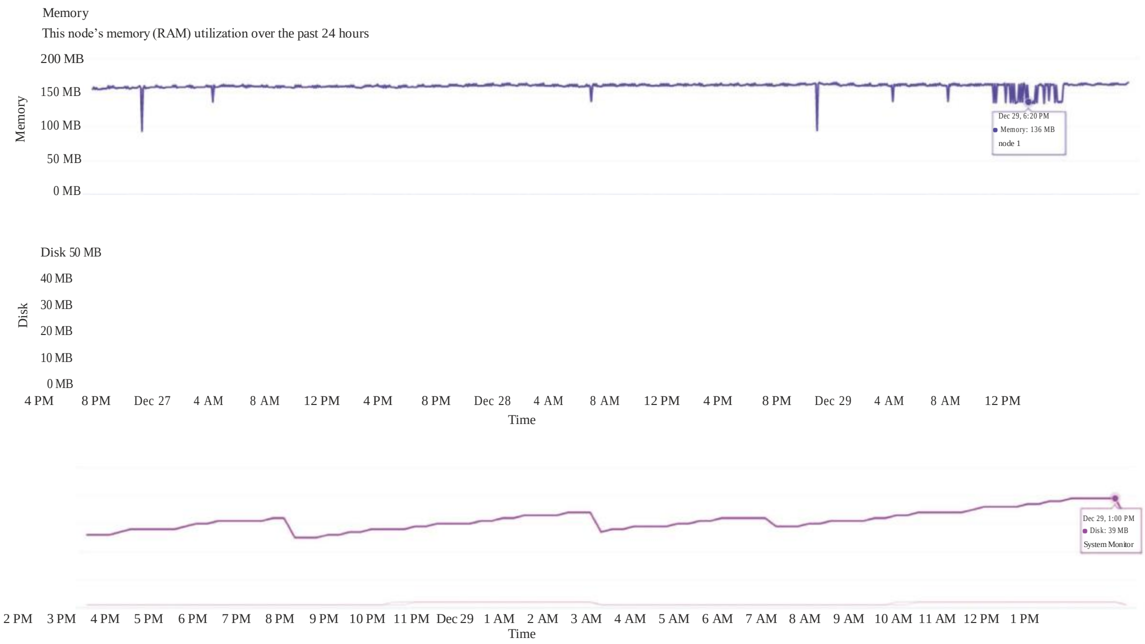
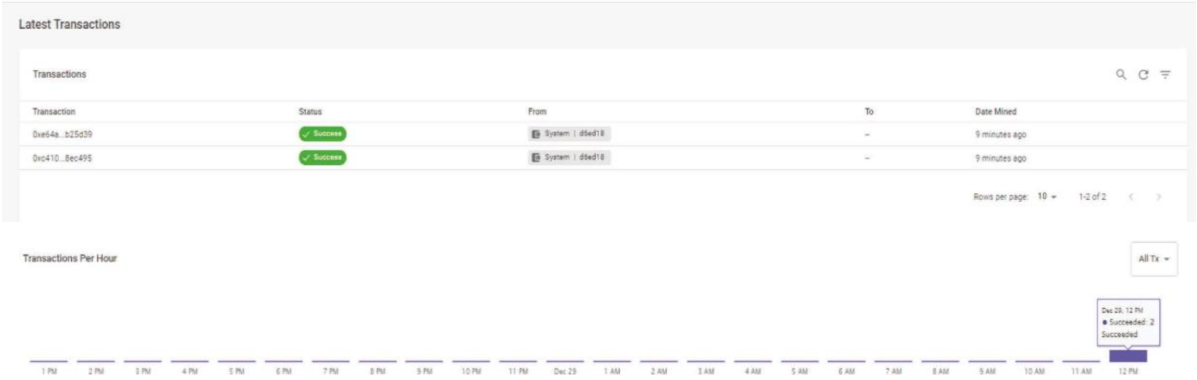


Figure 11: The minor impact of the smart contract script on the machine resources.



Latest Transactions

Transactions

Transaction	Status	From	To	Date Mined
0xe64a...b25d39	✓ Success	System | d6ed18	–	9 minutes ago
0xc410...8ec495	✓ Success	System | d6ed18	–	9 minutes ago

Rows per page: 10 1-2 of 2

Transactions Per Hour

Figure 12: Several successful block node transactions.

The suggested architecture also maintains confidence between entities. Before acquiring a product, it guarantees that the consumer is adequately informed about the repu- tation of other sides (the seller). Furthermore, the earlywarning feature is added to reduce the usage of chemicals and establish the safety of agricultural produce.

Though bitcoin popularized blockchain transactions, putting it in a real-world use case still has various difficultiesand many goals to achieve. Nevertheless, blockchain is stillin its early phases and contains serious flaws. Also, the applications are a considerable challenge to optimize the solutions and the entire food supply chain.

We all agree that the procedures are automated anddependable after these analyses. Smart contracts periodicallyself-check data, keep track of all the details, and help save data to the blockchain. When it comes to the blockchain, thedate, time, and product identifier allow all participants to track products and assure that they have access to infor- mation about the source of the products. The integrity is not threatened because the only participants authorized were those who could execute operations. Furthermore, usingsmart contracts eliminates the need for an intermediary party, and no one can alter the data inside the blockchain after it is verified.

So, it will be impossible to change the data if someone does something wrong or by mistake. Also, data collection relies on IoT devices; if they get broken, data collection is impossible. Furthermore, IoT devices are sometimes subject to security vulnerabilities.

Possibly, some participants cannot comprehend the system or blockchain technology. They may have limited knowledge or a lack of understanding of some functional- ities. Perhaps we cannot persuade some participants to give information. But, in general, the system offers a radical change in all aspects of an existing business.

The comparison system (see Table 1) provides all the details we have discussed. It is conceivable that the proof-of-work consensus mechanism is the algorithm that operates when the system employs the Ethereum platform. However, we have found that many studies neglect to include this point.

4. Performance Evaluation

Throughput is probably the most misunderstood perfor- mance testing principle that beginner testers occasionally have trouble mastering. In general, “throughput” refers to the volume of transactions generated throughout the test. It may also be described as the minimum amount of capacity that an application or website can handle.

Additionally, it is typical to set a throughput goal for theapplication before beginning a performance test run so that it can handle a certain number of requests per hour.

The suggested model, for instance, uses multiple blockchains. User information blockchain, agri-product information blockchain, and transaction informationblockchain are the three blockchains. Let us assume that, regardless of the volume or quantity of the data, it always takes one second to save a new set of three records on each block of the blockchain that we have.

A performance report for this scenario would reveal that the throughput is three records per moment. For more explanation, the user information blockchain can save the first recording data, the agri-product information block- chain can keep the second recording data, and the trans- action information blockchain can save the third recording data. This thinking is our maximum throughput, but the goal now is to increase it by updating the programming level of smart contracts by incorporating new methods and func- tions that reduce execution time and work to prevent bottlenecks in the blockchain network.

The first issue users have represented in transactionlatency is the delay between initiating a transaction orpayment and receiving confirmation that it is valid. Youwould anticipate a flattening of the throughput once all usershave logged in, begun to work, and sent requests. In our case,however, we have not added cryptocurrency-based financialtransactions yet, and the project’s goal is to simultaneouslyreceive data from sensors and send it to the blockchainnetwork. Hence, the automated system of smart contractshelps data arrive in any case and in good time for analyses.With minimal competition, throughput varies by simply adjusting the load while latency remains constant. Thereason is that whatever comes in comes out directly sincethere is a reasonable minimum cost to complete a transaction, and the queuing time is zero at low congestion.

Every newly formed block has a timestamp. The blockchain system uses timestamps to count the number of blocks added and produced during specific time intervals, such as per hour. The transaction latency metric can be calculated by looking up each transaction’s timing and comparing the time it got completed to the time it was approved and saved. This measure can also reveal the speedat which consensus methods got used. The outcomes of thesetests provide evaluations of the blockchain system’s func- tionality and scalability.

A 3.5 GHz CPU device with 32 GB RAM and a 3 TB harddrive will execute the model (Ethereum blockchain network—8 nodes) with a margin of 100–120 seconds for latency and a margin of 235–260 transactions per second (TPS) for throughput. Data must wait to get transferred when the local network’s capacity gets exceeded by traffic. Naturally, there will be more delay as a result. The latency will increase as the network becomes more crowded and wehave many activities simultaneously. However, solid wireless signals make it possible for data to be transported from the source to the destination within a short period and decrease latency. Adding more controllers or validators who confirm blockchain transactions may boost performance.

The analyzers must measure a large-scale distributed system to identify obstacles or blockages and predict ex- pected behavior under pressure.

4.1. Security Analysis. Now we will go on to the security analysis part, where we will list all of the model's compo- nents and discuss how they can provide security services and how they operate together to secure our data and deliver accurate information to all network members.

Smart contracts, apps, and the blockchain environment are vulnerable to attacks if the model gets weakly built. Let us start with the blockchain-based system, a public ledger of data kept on all nodes, with all participants receiving the same version of information and updates in real time as datachanges. Furthermore, users authenticate using public-key cryptography, and validators check the data for accuracy before storing them in blocks; thus, all data transactions ought to have acceptance from all nodes in the network. Finally, once transactions get preserved in blocks, no one or entity may edit or alter the block's content.

The level of security in the blockchain scheme is in- triguing, but let us now discuss smart contract security, which is more than simply a software program that gets run automatically. It is a part of the system. In our example, it can receive, transmit, and store data about the environment, such as temperature, humidity, light, and soil pH. It can alsotrack down the merchandise and determine which company owns it. We must not forget that smart contracts specify the extent of an agreement between business parties by definingcriteria that function as a trigger event in the contractual terms. The code gets performed, and the results get displayedon all of the network's nodes. Smart contracts get written conditionally, using if-then expressions, and thus neglect many of the problems caused by regular agreements, such asfraud. The use of blockchain to establish these types of arrangements eliminates the need for an intermediary. As a result, the total expenditures of the company get reduced. Toprevent losses, professionals make timely code optimiza- tions, conduct frequent code audits, and monitor the ab- errant behavior of implemented deals.

Unless you install protection, IoT devices might be the weakest link in terms of security. For example, the IoTconfronts fake cell tower assaults and threats such as man-in-the-middle attacks and SMS attempts such as phishing. Blockchain technology has been a remarkable example of providing safety in transactions and information transfer. It offers a unique data structure in addition to integrated se- curity measures. Consensus, decentralization, and cryp-tography—which ensure the trust of transactions—are the foundations of the blockchain.

However, poor technical implementation has led to several security vulnerabilities with blockchain. Although blockchain has significant security flaws, cyber security experts with special analytical and technical skills may take some steps to minimize these problems and implement blockchain in the safest possible way. Although the sug- gested approach may not stop these attempts, it makes it difficult for hackers to carry them out.

A 51% assault happens when one person or group of hackers gather more than half of the hash rate and takes over the entire system, which may be fatal for blockchains that handle financial transactions. In this case, hackers can alter transactions and stop the verification process. In sequence, the entire model will not add the transactions to the blocks. The attackers can even undo already finished transactions, which leads to double-spending. Thankfully, by increasing the hash rate and reducing the usage of proof-of-work techniques, we can avoid 51% assaults. The results concludethat this particular threat does not benefit the attacker itself because the main goal of the suggested agricultural model is to organize farm environmental data, distribute it to allnetwork participants, and provide a layer of security and confidentiality to these data.

Phishing attacks are seriously impacting blockchain networks. The purpose of a phishing attack is for the hackerto obtain the user's login information. To the owner of the wallet key, they may send emails that appear to be honest. The user must enter their login information into a false hyperlink that is connected. A user's passwords and other sensitive information may be compromised, which may cause harm to both the individual and the blockchain network. If blockchain network members get an e-mail asking for login information, they must confirm with the partner (other members, for example). Additionally, in- stalling malicious link detection software might aid in defending against this threat. We can point out that con- necting to the blockchain through public Wi-Fi could be risky.

Routing attacks, for example, are attacks when a hacker uses the anonymity of a user account to intercept data as theyget sent to Internet service providers. Data transfer andactivities continue as usual in the case of a routing attack, so the participants are typically oblivious to the threat. How- ever, establishing a secure routing protocol will solve this issue. The users of the network must use strong passwords and update them often. In practice, some farms are pretty likely to adopt this architecture, and there is a critical need tonotify every blockchain participant of the risks related to data security.

Users connect with the blockchain using electronic devices like computers and smartphones, which are theendpoints of the blockchain network. Hackers can target devices and monitor user activity to obtain the user's key. The participants should not save blockchain keys on com- puters as text files by network users. Identifying dangers andsecuring the device include installing antivirus software.

Hackers could consider creating plenty of phony net- work nodes (Sybil attack). They can gain majority consensus and stop the chain's transactions using this technique. Massive Sybil strikes implied a 51% attack. The suggested approach utilizes suitable consensus methods and keepstrack of the actions of other nodes.

Smart contract vulnerabilities can be risky because theycan lead to security flaws in the source code. In this case, the code is straightforward, only analyzes information, detects crop growth conditions, and assesses the state of the product.Our smart contract source code will continually get updated.For instance, we may utilize the Oyente Analysis Tool to find vulnerabilities in contracts built on Ethereum. This tech- nique evaluates the bytecode of the Ethereum blockchain.

The goal of analyzing and measuring connectivity, monitoring sensors, and making intelligent modifications and enhancements is to maximize price and quality. IoT devices generally use Linux operating system, typically the customized version. Data are protected when they flow fromthe local machine to the other scheme stages in IoT security(blockchain and smart contract layer). IoTdevices frequentlyhave a mobile application and are used to connect to devicesvia the Internet. When monitoring the sensors wirelessly, use a VPN to connect to them. Man-in-the-middle attacks will never be possible with a VPN solution. Block unneedednetwork ports, for example, the Telnet port should be deactivated to prevent further Telnet protocol attacks. By allowing traceable proof of ownership of products and by integrating unique tags (e.g., RFID, NFC, and QR codes) to create smart tags, we can add a few supply chain logistics to ensure traceability and protect the information exchanged through blockchain.

5. Conclusion and Future Work

In conclusion, blockchain and IoT technologies can aid in developing a secure, transparent, open, and innovative ecological agriculture system that involves all participants. This work aims to provide a possible technique to build practical blockchain-based applications and change theagriculture industry, even though the evolution of block-chain and agriculture research studies is still in its infancy.This model is considered a prototype for reducing financialloss and agricultural pollution. The system defines the threeprimary entities in the agriculture domain: data, process, andstakeholders. Adding a cryptocurrency process for the in-teraction between the entities and registering/tracking theseller's land will be a big step for this blockchain system model.

Data Availability

The data used to support the findings of this study areavailable from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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Demo link :

https://youtu.be/OubvhpYJx6o?si=CbUo0V4a-gOQCvTl

Github link :

https://github.com/au8146814620114008/farmer-insurance-chain.git