**Form 3 : Methodology**

1. **Team No :** 20
2. **Project Title :** Blockchain Technology in Agriculture Product Supply Chain
3. **Proposed Method :**

Block chain is a distributed database containing all networked transactions. Each part of this database is a “block” As transaction state shits, a block with a connection to the previous block is added to the block chain in a linear and sequential order. Then the new block is replicated over the network, so that each node has the same block chain. Each participant in this transaction has a copy of a block chain on it. Therefore, any participant can validate a particular transaction. This approach removed the need for the centralized, trusted confirmation of transactions by third parties. Block chain technology has a wide variety of uses, and tremendous innovation potential. Therefore, business leaders will use this technology to explore the range of opportunities open to their company and their industry.

1. **Proposed Method Illustration :**

Implementing blockchain technology in the agriculture product supply chain can bring transparency , traceability and efficiency to the entire process.

**Farm-to-Table Blockchain System:**

* **Smart Contracts for Agreements**: Farmers, distributors, and retailers enter into smart contracts using blockchain technology. Terms and conditions, including pricing, delivery schedules, and quality standards, are encoded into the smart contracts.
* **Crop Monitoring with IoT**: Internet of Things (IoT) devices such as sensors and drones are deployed on farms to monitor crop growth, environmental conditions, and pest control.

**Harvest and Processing:**

* **Blockchain for Traceability :** Each batch of harvested crops is assigned a unique identifier recorded on the blockchain. Details such as harvest date, location, and initial quality assessments are added to the blockchain.

* **Quality Control with Smart Devices:** Smart devices at processing facilities scan and record the quality and quantity of the harvested produce. The results are stored on the blockchain, creating an immutable record of the product's condition.

**Distribution and Logistics:**

* **Real-Time Tracking:** Utilize blockchain to create a decentralized ledger for real-time tracking of products during transportation. RFID tags or QR codes on product packaging can be scanned at different checkpoints, and the information is updated on the blockchain.
* **Automated Payments:** Smart contracts automatically trigger payments to farmers as the products move through the supply chain, ensuring prompt and fair compensation.

**Retail and Consumer End**

* **Transparent Product Information:** Consumers can access a blockchain-based platform or mobile application to obtain detailed information about the journey of the product from the farm to the store. Information such as cultivation practices, transportation details, and quality assessments is readily available
* **Product Authentication:** Use blockchain to enable product authentication, preventing fraud and ensuring that consumers receive genuine, high-quality products.

**Blockchain Consortium for Governance :**

* **Decentralized Authority**: Establish a consortium of stakeholders including farmers, distributors, retailers, and regulatory bodies to govern the blockchain network.

Each participant in the consortium has a node in the blockchain network, ensuring decentralized control.

* **Data Privacy and Security:** Implement robust encryption and access controls to safeguard sensitive information on the blockchain.

By implementing this proposed method, the agriculture product supply chain can benefit from increased efficiency, reduced fraud, improved traceability, and enhanced trust among stakeholders. The blockchain-based system creates a transparent and tamper-resistant record of each product's journey, fostering accountability and sustainability in the agricultural industry.

1. **Parameter Formulas :**

1. **IoT Device Density (IDD):**
   * IDD = (Number of IoT devices deployed / Total area of agricultural land)
   * Measures the density of deployed IoT devices per unit area of agricultural land, providing insights into the extent of IoT coverage.
2. **Data Generated by IoT Devices (DGI):**
   * DGI = (Total data generated by IoT devices / Time period)
   * Quantifies the volume of data generated by IoT devices over a specified time period, reflecting the information flow within the supply chain.
3. **Blockchain-IoT Integration Efficiency (BIE):**
   * BIE = (Number of successfully integrated IoT devices with blockchain / Total IoT devices deployed) \* 100
   * Assesses the efficiency of integrating IoT devices with the blockchain network, ensuring seamless communication and data synchronization.
4. **Smart Agriculture Process Automation (SAPA):**
   * SAPA = (Number of agricultural processes automated by IoT and smart contracts / Total number of processes) \* 100
   * Measures the percentage of agricultural processes automated through the combined use of IoT and smart contracts.
5. **Energy Efficiency of IoT Devices (EEI):**
   * EEI = (Total energy consumed by IoT devices / Data transmitted or processed)
   * Evaluates the energy efficiency of IoT devices by assessing the energy consumption per unit of data processed or transmitted.
6. **Supply Chain Visibility Index (SCVI):**
   * SCVI = (Number of IoT-tracked supply chain events / Total supply chain events) \* 100
   * Represents the extent to which IoT devices contribute to supply chain visibility, ensuring real-time tracking of product movements.
7. **Quality Assurance Ratio (QAR):**
   * QAR = (Number of quality parameters monitored by IoT devices / Total number of quality parameters) \* 100
   * Quantifies the percentage of quality parameters monitored by IoT devices in comparison to the total quality parameters relevant to agricultural products.
8. **Regulatory Compliance Assurance (RCA):**
   * RCA = (Number of regulatory compliance checks performed by IoT devices / Total compliance checks) \* 100
   * Measures the degree to which IoT devices contribute to ensuring regulatory compliance in the agricultural supply chain.
9. **Environmental Impact Reduction (EIR):**
   * EIR = (Reduction in environmental impact attributed to IoT-enabled precision farming / Baseline environmental impact)
   * Evaluates the percentage reduction in environmental impact achieved through the implementation of IoT-enabled precision farming practices.
10. **Real-Time Environmental Monitoring (RTEM):**
    * RTEM = (Number of environmental parameters monitored in real-time by IoT devices / Total relevant environmental parameters)
    * Represents the percentage of environmental parameters being monitored in real-time by IoT devices, contributing to sustainable and data-driven decision-making.

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