A secure and intelligent public distribution system (SIPDS) based on deep learning and Ethereum using predictive analytics for supply chain services

Abstract:

- Introduces Secure and Intelligent Public Distribution System (SIPDS)

- SIPDS comprises blockchain-based data security and predictive analysis components

- Developed secure distribution system on Ethereum platform

- Used specialized blockchain approach, smart contracts, and deep learning for analysis

- Evaluated model performance with metrics (MAE, RMSE, R2 score) for insights

Keywords:

- Public distribution system

- Blockchain innovation

- Deep learning

- Ethereum

- Digital contract

- Forecast analytics

1. Introduction:

- Global concern for food safety and accessibility

- India's Public Distribution System (PDS) faces challenges

- PDS requirements: information sharing, reliable results, data protection

- Blockchain ensures decentralized, secure, and reliable transactions

- Ethereum blockchain used for secure agreement and smart contracts

- Blockchain impact on data science industry, reliable record-keeping

2. Machine Learning and Deep Learning:

- Various machine learning methods for PDS data analysis

- Modern ML techniques for reliable forecasting models

- Deep Learning (DL) approaches, especially Deep Neural Networks (DNNs)

- DNNs enhance feature representation for improved learning models

3. Challenges in Public Distribution System:

- PDS complexity, intermediaries, and inefficiencies

- Ineffective food security initiatives due to improper handling and infrastructure

- Inadequate oversight leading to wastage, theft, and corruption

- Need for technological modernization, blockchain integration

3.1 Contribution of the Method:

- Blockchain ensures data quality, availability, and transparency

- SIPDS on Ethereum permissioned blockchain for secure communication

- Digital contract-based data treatment for effective resource management

- Predictive module refines Deep Learning-based forecasting models

- User-friendly interface, permissioned blockchain network, security ensured

- Performance evaluation using MAE, RMSE, and R2 score metrics

3.2 Designed Blockchain-based SIPDS:

- SIPDS comprises computer networks for commodity distribution and data sharing

- Blockchain-based model for secure and transparent ledger

- Smart contracts verify transaction records based on predetermined conditions

- Multi-user categories and REST API server for interaction

- Predictive analytics model for enhanced future actions

3.7 SIPDS Implementation:

- Separate front-end and back-end development phases

- Back-end development tools: Remix IDE, Ethereum, Sublime Text

- RESTful API for data retrieval from blockchain-based application

- Front-end technologies: HTML5, CSS3, Bootstrap, JQuery

- Predictive analytics model deployment environment and operational phases

4. Results of SIPDS Prediction:

- Experimental findings of forecasting component using regression models

- Commodity and quantity-wise forecasting with time-series and additional data

- Regression models for daily sales prediction using sklearn library

- Evaluation metrics: MAE, RMSE, and R2 score

- Comparison of BiLSTM, LSTM, and GRU algorithms for prediction efficiency