CROP YIELD PREDICTION USING NDVI AND DEEP LEARNING TECHNIQUES

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Introduction:

1. Agriculture plays a vital role in global food security and economic stability. With increasing population and climate variability, accurate crop monitoring and yield prediction have become essential. Traditional methods relying on field surveys are time-consuming, labor-intensive, and often inaccurate at large scales.
2. Recent advancements in remote sensing and artificial intelligence provide efficient alternatives. Satellite-based vegetation indices such as NDVI (Normalized Difference Vegetation Index) enable continuous monitoring of crop health and growth patterns. However, NDVI alone is insufficient to capture the full complexity of crop yield, as environmental factors such as temperature, rainfall, and soil conditions also play significant roles.
3. To address this, integrating satellite imagery with agro-meteorological data using deep learning models offers a promising solution. Long Short-Term Memory (LSTM) networks are particularly effective for modeling temporal dependencies in agricultural data. This project proposes an integrated framework that combines NDVI data, climate variables, and deep learning techniques for accurate crop identification and yield prediction.

Objectives:

1. To develop a centralized agro-meteorological data repository by integrating satellite-derived NDVI data, meteorological parameters, and other relevant environmental datasets to support agricultural analysis and decision-making.
2. To design and implement a crop identification algorithm using NDVI-based analysis for accurate classification of crop types through value-matching and pattern recognition techniques.
3. To develop a predictive crop yield model using advanced deep learning techniques (LSTM) by leveraging historical agro meteorological data and real-time inputs to enable reliable yield forecasting and farmer-centric decision support

Methodology:

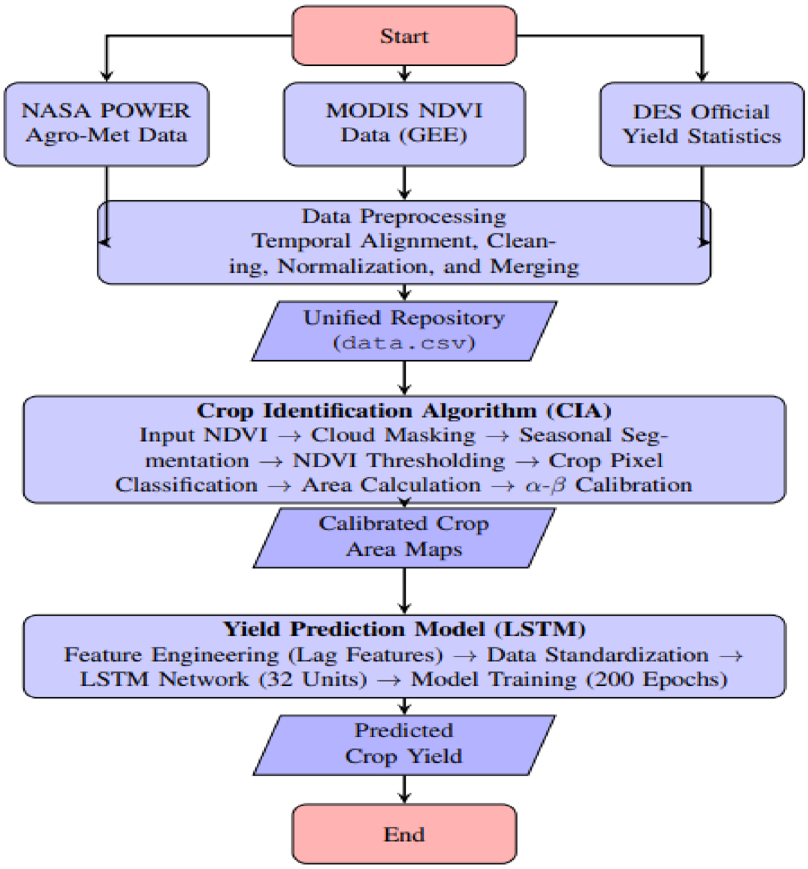

Figure 1: Overall methodological framework integrating NDVI time-series, agrometeorological parameters, and deep learning for crop identification and yield

The proposed system consists of three main stages:

1. Data Collection and Preprocessing

- NDVI data (MODIS) and climate data (NASA POWER) are collected.
- Data is cleaned, normalized, and merged into a unified dataset.

2. Crop Identification Algorithm (CIA)

- NDVI time-series data is processed using Google Earth Engine.
- Seasonal segmentation (Kharif, Rabi, Summer) is applied.
- Thresholding is used to classify crop and non-crop areas.
- Crop area is calculated and calibrated using regression techniques.

3. Yield Prediction using LSTM

- Historical NDVI and climate data are used as input.
- Lag features are added to capture temporal dependencies.
- An LSTM model is trained using TensorFlow/Keras.
- The model predicts future crop yield based on past patterns.

Result and Conclusion:

The proposed system demonstrates high accuracy in both crop identification and yield prediction. The Crop Identification Algorithm effectively maps cropland areas using NDVI data. The LSTM model achieves strong predictive performance with minimal error.
The predicted yield closely matches actual values, indicating the reliability of the model. This integrated approach proves to be more efficient and scalable compared to traditional methods.
Overall, the project successfully shows that combining satellite data, climate variables, and deep learning can significantly improve agricultural forecasting and decision-making.

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Future Scope:

The future scope of this project includes:

1. Extending the model to multiple crops and regions across India.
2. Using high-resolution satellite data such as Sentinel-2 for better accuracy.
3. Developing a real-time web or mobile-based decision support system for farmers.