Abstract

Accurate solar radiation forecasting is essential for optimizing agricultural practices, especially in plant cultivation. This study introduces a hybrid model combining Convolutional Neural Networks (CNN) and CatBoost to predict solar radiation, leveraging deep learning and gradient boosting techniques. The CNN model extracts spatial features from weather data, while CatBoost improves prediction accuracy using categorical inputs. The results reveal that the hybrid model outperforms individual CNN and CatBoost models, achieving lower Mean Absolute Error (MAE) and offering more reliable forecasts.

In the **Enchanted Eden** plant nursery web application, this model provides users—ranging from hobbyist gardeners to professional farmers—with real-time, localized solar radiation predictions. Registered users, including farmers, can input their location and specific crop types to receive tailored cultivation recommendations based on solar radiation patterns. The system helps users plan their planting schedules and optimize the growth conditions for their plants, contributing to increased efficiency and crop yield.

Administrative staff oversee the integration of these advanced forecasting features, ensuring the model is accurate and up to date. The involvement of users in the form of feedback and cultivation data further refines predictions, enabling continuous improvement. This integration of machine learning with e-commerce and agricultural services positions **Enchanted Eden** as an innovative platform that combines technology with sustainable farming practices, empowering users with data-driven insights for smarter plant care.

Users and Their Roles:

1. **Guest Users**
   - Browse plant products and view general information on solar radiation and plant care.
   - Access basic information about the solar radiation forecasting tool.
2. **Registered Users**
   - Create accounts to access personalized features like receiving solar radiation forecasts for their location.
   - Get customized advice on planting and growing based on solar radiation data.
   - Provide feedback on their experiences to improve the accuracy of the predictions.
   - View detailed planting schedules and progress based on solar radiation forecasts.
3. **Admin Staff**
   - Manage the system by ensuring the solar radiation forecasting tool works accurately.
   - Regularly update weather and radiation data for more precise predictions.
   - Monitor user activity, handle feedback, and maintain the overall platform functionality.
   - Provide expert advice and customer support.