Notification Number : 554/2024

Notification Date : 14/02/2024

Name of the Scholar : Disha Garg

Name of the Supervisor : Prof. Mansaf Alam

Name of the Department/Centre : Department of Computer Science

Topic of the Research : Analytical Solutions for IoT Based Agricultural Data

Keywords : Internet of Things, Cloud Computing, Analytics, Feature Selection, Data Acquisition

Findings

Agriculture plays a pivotal role in the Indian economy, with a significant portion of the population directly or indirectly dependent on it. The advent of technology has brought about a paradigm shift in agricultural practices, replacing traditional approaches with more advanced methods. Recent advancements in technologies such as the Internet of Things (IoT), Machine Learning (ML), and Deep Learning (DL) have sparked interest among researchers in applying these techniques to the field of agriculture, as they have the potential to revolutionize farming practices, improve crop quality and yield, and meet the increasing global demand for food.

However, the challenges faced by the agricultural sector, particularly in developing countries like India, highlight the inadequacy of traditional techniques in meeting the demands of modern farming. Weather fluctuations, soil changes, and limited knowledge of farmers pose significant hurdles. Nonetheless, technological advancements and the integration of IoT-based analytics offer potential solutions. By implementing analytical solutions such as plant leaf disease detection, data acquisition and management framework, and real-time crop monitoring using sensors, farmers can make data-driven decisions, enhance agricultural productivity, and reduce risks associated with unforeseen circumstances.

This research explores applying analytical solutions to IoT-based agricultural data, delving into crucial agricultural activities such as soil and crop monitoring, plant and leaf disease detection, automated irrigation systems, livestock monitoring, fertilizer recommendations, greenhouse management, and weather forecasting. The goal is to identify the most effective approaches used in recent years by examining the interest of researchers in these activities and analyzing the prevalent data analytics types.

The study proposes a data acquisition and management framework to address the challenge of managing the enormous amounts of data produced by IoT devices in agriculture. This framework safely handles the data generated by IoT-enabled agricultural equipment, managing it from the point of generation by IoT devices to its availability for application development. In addition to data management, the study also proposes a sensor data acquisition framework for acquiring data from sensors mounted on unmanned aerial vehicles (UAVs) or robots. Real-time data on parameters such as temperature, humidity, moisture, and bacteria can be collected by deploying IoT-based sensors on these robots in crop fields. This data is then pushed to the Cloud for analysis, enabling better decision-making and resource optimization.

Furthermore, soil testing, which serves as the initial step in determining optimal nutrient levels for specific crops, plays a vital role in agriculture. Machine learning classification techniques can leverage soil nutrient data to recommend suitable crops. The study introduces the Wrapper-PART-Grid algorithm, a hybrid method that combines the grid search method for hyperparameter optimization, wrapper feature selection strategy, and the partial C4.5 decision tree (PART) classifier. This algorithm is used for crop recommendation and is compared with other ML techniques.

For the automatic detection of crop/plant diseases, convolutional neural networks (CNNs) have become common. However, these models have limitations in extracting relevant image features. To address this, the study proposes an algorithm that combines CNN and Recurrent Neural Network (RNN) models. This algorithm focuses explicitly on extracting relevant image features from images of diseased apple leaves. The algorithm's performance is evaluated using various metrics such as accuracy, precision, recall, and F1-score.

Overall, this study aims to address the need for advanced analytics in agriculture and contribute to developing and adopting analytical solutions in the field. Farmers can gain valuable insights, optimize resource allocation, and ensure sustainable agricultural practices by leveraging IoT, ML, and DL. The study delves into specific analytical solutions, their implementation, and the benefits they bring to the agricultural sector.