Revolutionizing soybean disease detection using the internet of things with deep convolution networks†

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Soybean diseases pose a significant obstacle to the increase in worldwide demand for soybean, leading to significant reductions in production. This study introduces an innovative approach that utilizes convolution neural network (CNN) and the internet of things (IoT) to efficiently identify and categorize various types of soybean leaf infections. A deep CNN model has been developed using the AlexNet architecture to effectively classify soybean plant diseases. A collection of 11,493 leaf images of 14 soybean diseases, including healthy plants was acquired from the ground using IoT devices and camera modules. Achieving 99.39% and 97.01% accuracy and F1-score respectively, helps not only in early disease detection, but also brings about a transformative approach to sustainable soybean crop management. This initiative lays the foundation for a strengthened agricultural future, enabling increased crop production and improved economic well-being in the cultivation of soybean, all facilitated by the integration of innovative technologies.

Keywords: Convolution networks, image augmentation, machine learning, soybean plant disease, sustainable crop management.

in traditional farming practices. Embracing technology with great enthusiasm, the agricultural sector is dedicated to enhancing efficiency, sustainability and overall productivity. Soybean production assumes a pivotal role in the agricultural and economic landscapes of numerous nations, exerting influence on trade, employment, food security and industrial development[2,3].

Soybean seeds, containing approximately 40% protein and 18% oil, are an affordable and crucial source of high-quality proteins for living organisms. A report published in 2016 by the Federation of Indian Chambers of Commerce and Industry (FICCI), mentions that the country produces 43% of the world's soybean oilseeds and 25% of all vegetable oils produced worldwide. Maharashtra and Madhya Pradesh (MP) together account for 89% of India's soybean acreage, making them the two primary soybean producing states. In 2022–23, the Soybean Processors Association of India (SOPA), in partnership with the ICAR-Indian Institute of Soybean Research, Indore, MP, reported that about 90% of the soybean grown worldwide is produced by five nations: USA, Argentina, Brazil, China and India[4]. An analytical study by Prabha Rani *et al.*[5] accentuates India's current position as the fourth-largest soybean producer globally and projects a surge in