TITLE: UTILIZING ZYNQ 7000 SOC FOR AUTOMATED PLANT DISEASE DETECTION

Literature Survey:

The detection of plant diseases is a critical aspect of agricultural management, as early diagnosis can prevent significant crop losses and ensure food security. Various studies have explored the use of image processing and machine learning techniques for automated plant disease detection, focusing on different crops and methods. This literature survey reviews several key studies, highlights their methodologies, and identifies research gaps.

Paper 1: Automated Leaf Disease Detection Using ZYNQ FPGA with CNN Acceleration (2023)

This paper introduces a system designed to detect leaf diseases using a Convolutional Neural Network (CNN), accelerated by the ZYNQ FPGA. The CNN architecture processes high-resolution plant images, and the FPGA accelerates convolution operations, enabling real-time disease detection. The main advantage of this approach is its ability to combine accuracy with speed while maintaining low power consumption, which is crucial for deployment in remote agricultural regions where energy resources are limited. Despite these strengths, the research is limited to leaf disease detection and does not explore the scalability of the system across multiple crop types or its integration with IoT systems for more comprehensive agricultural monitoring. This limits its broader applicability for farmers managing diverse crops. The diseases targeted in this research include Cercospora leaf spot, black rot, and mosaic virus, all of which are common in various crops.

Paper 2: Real-Time Image Processing on FPGA for Crop Disease Detection (2022)

The focus of this paper is on real-time disease detection using the ZYNQ SoC for hardware-accelerated image processing. The system leverages OpenCV and hardware accelerators to perform rapid image analysis, offering a practical solution for large-scale deployment in agricultural fields. The FPGA's speed in handling image processing makes it ideal for real-time crop disease detection, particularly in large farming operations where delays in identification could result in significant crop loss. However, the research does not incorporate advanced AI models, which could improve the system's disease recognition accuracy. Additionally, the system has not been tested on a wide variety of plant species or disease types, making it less versatile in diverse farming environments. The diseases addressed by this study include anthracnose, fusarium wilt, and leaf blight.

Paper 3: Implementation of Plant Disease Detection Using Deep Learning on FPGA (2021)

This paper implements a plant disease detection system using deep learning, specifically CNNs, on the ZYNQ 7000 SoC. The FPGA is used to accelerate inference operations while the processing system manages control functions, resulting in a faster, more efficient real-time disease detection process. The system demonstrates significant improvements in latency reduction compared to traditional platforms, highlighting the advantage of FPGA-based systems in agricultural applications. However, the research is limited to detecting common plant diseases, and the CNN model used could benefit from a larger, more diverse dataset for improved accuracy and generalization. Incorporating more advanced neural networks could also enhance its detection capabilities. The diseases targeted by this system include leaf blight, powdery mildew, and bacterial spot.

Paper 4: Plant Disease Classification Using Edge AI on ZYNQ SoC (2020)

In this paper, a machine learning model is deployed on the ZYNQ SoC using edge AI techniques for the real-time classification of plant diseases. The focus of the research is on providing a low-power, high-performance solution that minimizes the need for cloud computing, making it particularly useful for farmers in remote areas with limited internet access. The system performs well in real-time classification tasks, but the study does not explore more complex diseases that require multi-modal data inputs such as soil quality or climate data, which could enhance the accuracy of disease detection. The diseases studied in this research include late blight, early blight, and the leaf curl virus.

Paper 5: FPGA-Based Smart Agriculture System for Plant Disease Monitoring (2019)

This research develops an FPGA-based system utilizing the ZYNQ 7000 platform for real-time monitoring and early detection of plant diseases. The system integrates image analysis with environmental sensor data, creating a more comprehensive approach to disease monitoring. The combination of image processing and sensor inputs allows for quicker responses to detected diseases in agricultural fields. However, the system relies on simpler image processing techniques and does not incorporate deep learning algorithms, which may limit its accuracy when dealing with more complex plant diseases. The diseases addressed in this study include rust, downy mildew, and leaf spot.

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