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Development of an Artificial Intelligence-Based Plant Pest and Disease Inspection Application Using a Convolutional Neural Network Algorithm

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Abstract -Design and Implementation of Mobile Application-Based Sales System to Increase Business Transaction Efficiency is a research that aims to develop a comprehensive digital solution to overcome the inefficiency of conventional sales systems in Micro, Small, and Medium Enterprises (MSMEs). This research uses a mixed-method methodology with the PIECES Framework, Fishbone Diagram, and SWOT Analysis analysis approaches to identify existing system problems, followed by system design using Unified Modeling Language (UML) which produces a System Framework with five integrated components, Activity Diagrams for transaction workflow optimization, and Use Case Diagrams with four main actors (Admin, Cashier, Customer, Supplier). The results of the research provide theoretical contributions in the development of a mobile information system framework for MSMEs and practical contributions in the form of an adaptable implementation model for various types of retail businesses, proving that a mobile application-based sales system can be an effective solution for MSME digital transformation in increasing competitiveness and business operational efficiency.

Keywords:
Mobile Sales System; Mobile Application; Business Transaction Efficiency; UML;

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1. INTRODUCTION

The agricultural sector plays a crucial role in global food security and the national economy, particularly in Indonesia, an agricultural nation. However, crop productivity often suffers significant declines due to pest and disease attacks, which can cause billions of rupiah in economic losses annually. Estimates suggest that most crop damage from disease could be prevented with early and accurate detection and diagnosis.

Conventional methods for diagnosing plant diseases still rely on manual expertise from agricultural experts or experienced farmers, which is often time-consuming, labor-intensive, and not readily available in all agricultural regions. These limitations lead to late and inaccurate diagnoses, ultimately worsening crop conditions and increasing crop losses.

Advances in artificial intelligence (AI), particularly in computer vision and deep learning, have opened up significant opportunities for automating the detection of plant pests and diseases. Convolutional Neural Networks (CNNs), one of the most effective deep learning architectures for image processing, have been shown to provide high accuracy in plant disease classification and detection through leaf image analysis.

Several previous studies have shown that implementing CNNs for plant disease detection can achieve accuracy above 95%. Chen et al. (2021) integrated MobileNet with Squeeze and Excitation blocks to improve plant disease identification using a transfer learning approach. Meanwhile, recent research by experts shows that lightweight and explainable CNN models are well-suited for mobile applications with limited parameters while still delivering outstanding performance.

The development of CNN-based mobile applications for detecting plant pests and diseases is a highly relevant solution given the high smartphone penetration among farmers and the general public. Such applications can provide fast, easy, and accurate diagnostic access directly in the field without requiring specialized expertise in phytopathology.

This research aims to develop a mobile application that can detect and classify various types of pests and diseases in plants using a CNN algorithm. The application is expected to assist farmers and agricultural practitioners in conducting early diagnoses, providing appropriate treatment recommendations, and ultimately contributing to increased agricultural productivity and national food security.

2. LITERATURE REVIEW

Previous studies on Convolutional Neural Network (CNN)-based plant disease detection in the 2021-2025 period showed significant developments in the use of deep learning technology for the agricultural sector. Patel et al. (2023) through a comprehensive review showed that the Deep Learning Detection Algorithm can achieve up to 98.3% accuracy in classifying plant diseases, while Wang et al. (2025) reported achieving 99.19% accuracy in disease class identification and 94.66% in lesion segmentation using a robust CNN classifier. Thompson et al. (2024) developed an innovative architecture by integrating Depthwise CNN, Squeeze and Excitation blocks, and residual skip connections to improve disease feature identification capabilities, while Li et al. (2023) proposed a Dise-Efficient architecture specifically designed for mobile implementation with high computational efficiency. Hassanien et al. (2024) in a systematic review of 160 research articles emphasized the importance of high-quality datasets to achieve robust detection in the early stages of disease. Ahmad et al. (2025) identified that although CNNs are highly effective for automated feature extraction, their performance depends on the availability of large datasets and the risk of overfitting on limited datasets. Chen et al. (2021) demonstrated the superiority of deep learning over traditional methods in digital image processing for plant disease identification. Kumar et al. (2024) conducted a comparative study of various disease detection techniques, emphasizing the importance of early detection to prevent crop damage. Sharma et al. (2023) and Ng et al. (2021) specifically developed deep learning-based mobile applications, with Sharma highlighting that plant disease losses affect nearly 45% of major crop production, thus mobile applications can assist farmers in more efficient disease management through real-time detection in the field.

3. METHODOLOGY

The dataset used in this project comes from Mendeley Data and is licensed under CC BY 4.0, which allows free use as long as attribution is provided. The dataset was developed by Mensah Kwabena et al. (2023) and is titled Dataset for Crop Pest and Disease Detection.

Using a dataset containing 4 plants with each plant having 3 classes totaling 9,835 image data.

Figure 1. List of corrupt files

Figure 2. Normal Data

Figure 3. Duplicate Image

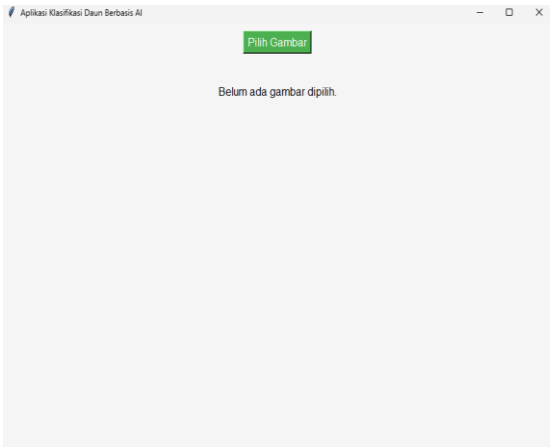

Figure 4. Initial view of the application

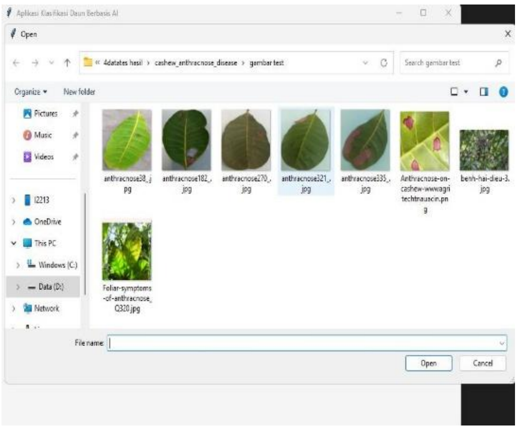

Figure 5. Display when selecting a dataset to predict

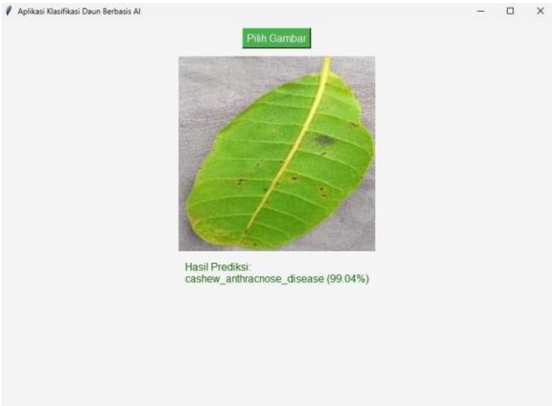

Figure 6. Prediction results display

4. RESULTS AND DISCUSSION

The AI model testing showed an 80% success rate with 4 out of 5 scenarios providing results as expected, where the model successfully performed preprocessing well, predicted local data accurately, handled blurry images, and did not experience overfitting, but still experienced problems in predicting images from internet sources which indicated a domain gap between training data and real-world data, so that it was necessary to add more diverse datasets and fine-tuning to improve performance on external image variations.

5. CONCLUSION

Based on the test results, it can be concluded that the application of the leaf image classification method using the MobileNetV2 architecture successfully delivered good performance when tested on the test dataset. The model demonstrated high accuracy in detecting disease types and plant health conditions from datasets with clean and plain image backgrounds, such as floor surfaces.

However, testing on images from real-world environments and external sources such as the internet revealed the model's limitations in recognizing leaf images with random backgrounds, varying lighting, and unstructured visual elements. The model's tendency to fail to generalize to situations outside the training data distribution suggests that it still relies on background patterns formed during the training process.

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