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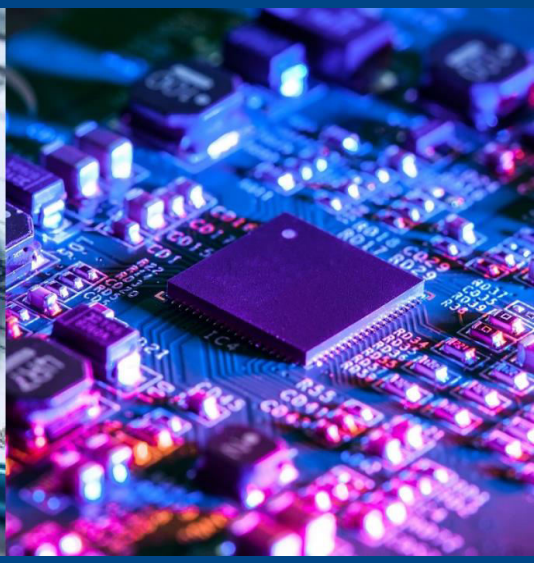

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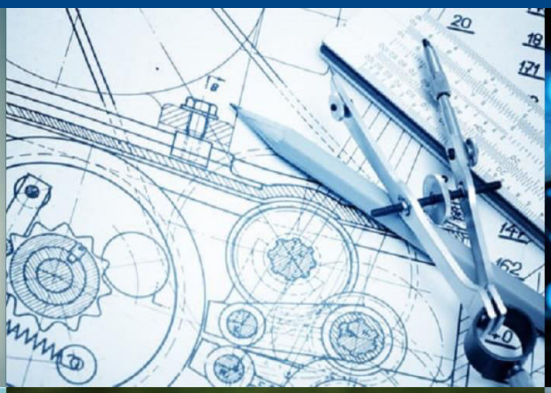

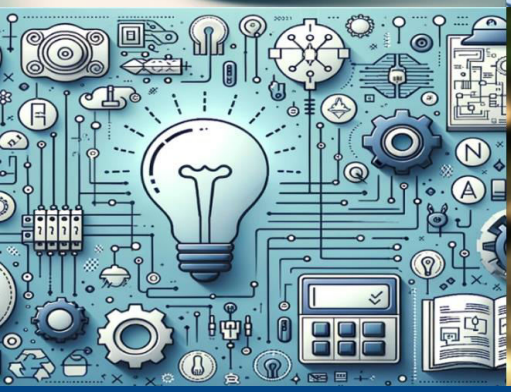

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Real-Time Mobile Application for Coconut Pest Identification Using Convolutional Neural Network Algorithm

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ABSTRACT: Coconut pest infestation remains a serious problem for farmers in Lanuza, Surigao del Sur, especially since many of them depend on coconut farming as their main source of income. Most farmers identify pests by manually checking their crops, which can take time and may not always be accurate. Because of this, pests are sometimes detected too late, causing damage to the crops and lowering production and income of farmers in the area. To help solve this problem, CocoGuard was developed as a mobile application that helps farmers identify coconut pests using images. With this app, users can take a photo or upload an image of a coconut leaf or any affected part of the plant, and the system will quickly identify the pest and provide suggested ways to manage it properly. The app also includes a pest library and a history feature so farmers can track and monitor pest issues over time and make better decisions. The system uses an image classification model called MobileNetV2, which was trained using a dataset of coconut pest images and optimized to work well on mobile devices for fast results in the field. The system reached an accuracy of 92% and showed good performance in identifying different pests. It was also tested using the ISO/IEC 25010 model, and users gave positive feedback, saying the app is easy to use, reliable, and helpful.

KEYWORDS: Coconut Pest Detection, Mobile Application, Image Classification, MobileNetV2, Coconut Farming, Pest Management

I. INTRODUCTION

Coconut farming plays a vital role in the livelihood of many families in Lanuza, Surigao del Sur. However, pest infestations continue to threaten coconut production, causing crop damage and financial losses among farmers. Traditional pest detection methods mainly rely on manual inspection, which is often slow and inaccurate, resulting in delayed treatment and increased infestation. Because of this, there is a growing need for a faster and more reliable method of identifying coconut pests.

Recent studies have shown that Convolutional Neural Networks (CNNs) can effectively identify pests and diseases through image recognition technology. Noor and Solaiman (2025) explained that CNN-based systems provide fast and accurate crop disease detection, while Deng et al. (2023) highlighted that integrating AI into mobile applications makes the technology more accessible to farmers. In addition, Wulandari et al. (2023) emphasized that lightweight CNN models can operate directly on mobile devices even with limited internet connectivity, making them suitable for rural farming communities.

This study is relevant because it proposes the development of a real-time mobile application for coconut pest identification using a CNN algorithm. The application aims to help farmers quickly detect pests, receive proper treatment recommendations, and make informed decisions directly in the field. By integrating artificial intelligence with a user-friendly mobile platform, the study seeks to improve pest management practices, reduce crop losses, and support sustainable coconut farming. Furthermore, the research contributes to the growing use of modern technology in agriculture by providing a practical and accessible solution for rural farming communities.

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II. LITERATURE SURVEY

The use of technology in agriculture has evolved from traditional manual inspection to artificial intelligence (AI)-based systems that help farmers detect crop diseases and pests more efficiently. Early agricultural studies focused on image processing techniques, but recent advancements in Convolutional Neural Networks (CNNs) significantly improved the accuracy of pest and disease identification through image recognition.

Noor and Solaiman (2025) explained that CNN-based systems provide fast and accurate crop disease detection, while Deng et al. (2023) highlighted that integrating AI into mobile devices makes the technology accessible to farmers without requiring expensive equipment or technical expertise. Researchers also focused on developing lightweight AI models suitable for smartphones and rural environments. Wulandari et al. (2023) found that CNN models can run directly on mobile devices without continuous internet connectivity, making them effective for rural farming communities. Similarly, Hosen, Ahmed, and Haque (2024) stated that mobile AI tools are becoming practical solutions for small-scale farmers because of their affordability and portability.

In the Philippines, coconut farming remains vulnerable to pests such as the rhinoceros beetle, red palm mite, and coconut leaf miner. Traditional pest identification methods are often slow and inaccurate, resulting in crop damage and reduced productivity. To address this problem, local researchers explored AI-driven agricultural solutions. Dela Cruz et al. (2022) demonstrated that CNN-based models achieved over 92% accuracy in identifying crop diseases. However, Santos and Lim (2024) emphasized that localized datasets are important because foreign-trained models often fail to accurately identify Philippine coconut pests due to environmental and pest differences.

Recent studies also focused on mobile-based agricultural applications. Daga et al. (2025) developed a lightweight CNN-powered application optimized for low-end Android devices, reducing pest misidentification by approximately 65% during field testing. Likewise, the Philippine Coconut Authority and Mapúa University (2025) introduced the CocoGuard system, which provides real-time coconut pest identification and pest management recommendations through a mobile application.

The reviewed studies show that CNN-based mobile applications are effective tools for pest detection and agricultural monitoring. Previous researchers confirmed that AI technology improves detection accuracy, reduces identification errors, and supports faster decision-making for farmers. However, many existing systems still rely on internet connectivity or are not specifically designed for Philippine coconut farming conditions. Therefore, this study aims to develop a lightweight and user-friendly mobile application that uses a CNN algorithm for real-time coconut pest identification, specifically designed to support coconut farmers in rural communities such as Lanuza, Surigao del Sur.

Table 1. Summary of Related Literatures

No.	Paper Title	Author/s	Key Points	Remarks
1	CNN-Based Crop Disease Detection	Noor & Solaiman (2025)	CNN systems provide fast and accurate crop disease detection through image recognition.	Supports the use of CNN algorithms for pest identification.
2	Mobile AI Applications in Agriculture	Deng et al. (2023)	AI integrated into mobile devices improves accessibility for farmers without technical expertise.	Supports the development of a mobile-based pest detection system.
3	Lightweight CNN Models for Smartphones	Wulandari et al. (2023)	CNN models can operate directly on mobile devices without continuous internet connectivity.	Supports offline and lightweight mobile AI implementation.
4	Mobile AI Tools for Small-Scale Farmers	Hosen, Ahmed, & Haque (2024)	Mobile AI tools are affordable, portable, and suitable for rural farming communities.	Supports the practicality of smartphone-based agricultural applications.
5	CNN-Based Crop Disease	Dela Cruz et al.	CNN models achieved over	Validates the

	Identification	(2022)	92% accuracy in crop disease detection.	effectiveness of CNN models in agricultural diagnostics.
6	Localized AI Datasets for Philippine Agriculture	Santos & Lim (2024)	Local datasets improve the accuracy of pest detection systems in Philippine conditions.	Supports the use of localized coconut pest image datasets.
7	Mobile Coconut Pest Detection Application	Daga et al. (2025)	Lightweight CNN applications reduced pest misidentification by 65% during field testing.	Supports real-time pest detection using low-end Android devices.
8	CocoGuard System	Philippine Coconut Authority &Mapúa University (2025)	Developed a CNN-powered mobile application for coconut pest identification and management.	Serves as a related study for mobile-based coconut pest detection systems.

The reviewed literature collectively supports the development of the CocoGuard mobile application by demonstrating how Convolutional Neural Networks (CNNs), mobile technologies, and artificial intelligence improve the accuracy, accessibility, efficiency, and reliability of coconut pest identification and agricultural monitoring systems. The studies also highlight the importance of lightweight mobile applications, localized datasets, and user-friendly interfaces in providing practical and effective solutions for coconut farmers in rural communities.

III. METHODOLOGY

Research Design

This study utilized a descriptive-developmental research design to develop and evaluate the CocoGuard mobile application for real-time coconut pest identification. The study focused on developing a user-friendly and efficient mobile application that uses a Convolutional Neural Network (CNN) algorithm to identify coconut pests and provide pest management recommendations for coconut farmers in Lanuza, Surigao del Sur.

The Agile Software Development Life Cycle (SDLC) was adopted as the development methodology. Agile allowed the system to be developed through iterative cycles or sprints, enabling continuous testing, improvement, and integration of user feedback throughout the development process. This approach helped improve both the mobile application interface and the AI model's accuracy and performance.

Instrument

The study used a researcher-made questionnaire based on the ISO/IEC 25010 Software Quality Model to evaluate the developed application. The questionnaire utilized a five-point Likert scale to assess the system's functionality, usability, reliability, efficiency, maintainability, compatibility, and security.

In addition, the performance of the CNN model was evaluated through actual system testing using coconut pest images to measure detection accuracy and response speed.

Data Collection and Participants

The respondents of the study included coconut farmers and selected agricultural workers from Lanuza, Surigao del Sur. Data collection involved interviews, surveys, observations, consultations, and actual system testing.

The researchers also collected approximately 9,000 coconut pest images from agricultural databases and actual coconut farms. These images focused on common coconut pests such as Rhinoceros Beetle, Red Palm Weevil, Palm Aphid, Mealybug, and Brontispa.

During system evaluation, respondents tested the application by capturing or uploading pest images, viewing scan results, accessing the Pest Library, and evaluating the overall usability and performance of the system.

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Data Analysis

The data gathered from surveys and system evaluations were analyzed using quantitative statistical methods.

1. Weighted Mean – Used to determine the average evaluation scores for the software quality characteristics of the CocoGuard application.
2. Standard Deviation – Used to measure the consistency of respondent evaluations.
3. Scale Interpretation – Used to interpret respondent ratings based on descriptive equivalents.
4. Accuracy Testing – Used to evaluate the performance of the CNN model in identifying coconut pests.
5. Qualitative Analysis – Used to summarize respondent feedback, observations, and recommendations for system improvement.

The collected data were used to determine the overall effectiveness, usability, reliability, accuracy, and acceptability of the CocoGuard mobile application for real-time coconut pest identification.

IV. RESULTS & DISCUSSION

This chapter presents the findings gathered from the system evaluation, user surveys, and testing conducted for the CocoGuard mobile application. The study focused on evaluating the effectiveness, usability, accuracy, and practicality of the application in real-world farming conditions. Data were collected from 100 respondents, including coconut farmers and agricultural workers in Lanuza, Surigao del Sur.

Farmer Profile and Current Pest Detection Practices

The survey revealed that most coconut farmers in Lanuza are highly experienced, with more than half of the respondents aged 50 years old and above. Many have been engaged in coconut farming for over 16 years. Despite their experience, farmers continue to face challenges in identifying pests such as the Red Palm Weevil and Stem Bleeding disease.

Results showed that all respondents still rely on manual visual inspection in detecting pests. This traditional method often leads to delayed identification, inaccurate diagnosis, and severe crop damage before treatment is applied. In addition, 63% of the respondents reported that they had never consulted agricultural experts due to limited access to agricultural support services.

However, the findings also showed positive acceptance toward technology-based solutions. Although many farmers are not regular smartphone users, 66% expressed willingness to use a mobile application if it could help improve pest detection and crop protection.

Table 2. Farmers' Current Pest Detection Practices

Indicators	Percentage (%)
Farmers relying on visual inspection	100%
Farmers who never consulted agricultural experts	63%
Farmers willing to use a pest detection app	66%

The findings support the study of Daga et al. (2025), which revealed that mobile-based pest detection systems help reduce pest misidentification and improve farmer response time during infestations.

System Performance and User Evaluation

The CocoGuard mobile application was evaluated based on usability, accuracy, speed, and overall user satisfaction. Results showed that the application performed effectively under actual farming conditions.

Most respondents found the application easy to use and navigate. About 50% of the participants strongly agreed that the interface was simple, clear, and user-friendly. This indicates that the application is accessible even to users with limited technological experience.

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The AI-powered CNN model also demonstrated high accuracy during testing. Approximately 46% of the respondents strongly agreed that the pest identification results were accurate and reliable. Furthermore, 50% of the respondents expressed satisfaction with the speed of the application, particularly its ability to provide immediate results after capturing or uploading an image.

Table 3. User Evaluation of the CocoGuard Application

Evaluation Criteria	Result
Users who strongly agreed the app is user-friendly	50%
Users satisfied with detection speed	50%
Users who strongly agreed the results are accurate	46%

These findings are consistent with the study of Dela Cruz et al. (2022), which reported that CNN-based agricultural systems achieved over 92% detection accuracy. Similarly, Foysal et al. (2024) found that mobile AI applications significantly reduced pest identification time while maintaining reliable performance.

System Features and Functionality

The results also showed that CocoGuard functions as more than just a pest scanning application. The system includes secure user authentication, image capture and upload functionality, scan history monitoring, and an integrated Pest Library containing pest treatment recommendations.

After identifying a pest, the application provides recommended solutions, including organic, chemical, and biological treatment methods. These features help farmers not only identify pests but also make informed decisions regarding pest management.

Table 4. Features of the CocoGuard Application

Features	Description
User Authentication	Allows secure account creation and login
Image Capture/Upload	Enables pest image scanning using camera or gallery
Scan History	Stores previous scans and confidence levels
Pest Library	Provides pest information and treatment recommendations

The findings demonstrate that integrating artificial intelligence with a user-friendly mobile platform can effectively support coconut farmers in identifying pests, reducing crop losses, and improving farming practices. The study also confirms that lightweight CNN-based mobile applications are practical solutions for rural agricultural communities with limited access to experts and internet connectivity.

V. CONCLUSION

This study successfully developed the CocoGuard mobile application, a real-time coconut pest identification system powered by a Convolutional Neural Network (CNN) algorithm. The application was designed to help coconut farmers detect common coconut pests quickly and accurately using mobile devices. By integrating artificial intelligence with a user-friendly interface, the system provided practical pest identification and management recommendations suitable for rural farming communities.

The findings revealed that the application performed effectively in terms of usability, accuracy, speed, and reliability. Farmers and agricultural workers positively evaluated the system, particularly its ease of use, fast response time, and accurate pest detection capabilities. The study also confirmed that lightweight CNN models can operate efficiently on mobile devices, making the application accessible even in areas with limited internet connectivity.

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Furthermore, the CocoGuard application serves as a practical and innovative solution for improving coconut pest management, reducing crop losses, and supporting sustainable farming practices. The study demonstrates how modern mobile and AI technologies can help bridge the gap between traditional agriculture and digital innovation, providing farmers with accessible tools for better decision-making and crop protection.

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