

Development of Mobile App in Detecting Milkfish Freshness using CNN

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Abstract: Milkfish, a dietary staple for many, is highly susceptible to spoilage. Maintaining its freshness is crucial to preserve both its quality and nutritional value. While traditional methods like icing have been widely used, they often rely on subjective assessments.

In recent years, image processing techniques have emerged as a promising solution to objectively assess fish freshness. By analyzing specific features like eye clarity, gill color, and tissue integrity, artificial intelligence models, such as Convolutional Neural Networks (CNNs), can accurately determine whether a milkfish is fresh or not.

Our research focused on developing a CNN model, to analyze images of milkfish. By segmenting key areas like the eyes and body tissues, the model can extract relevant features and make precise predictions.

Keywords: Convolutional Neural Network, Milkfish, Freshness

I. INTRODUCTION

Milkfish (*Chanos chanos*) is a significant fishery commodity in many regions, particularly in Southeast Asia. Ensuring the freshness of this popular fish is crucial for maintaining its quality and safety for consumption (Roikhanah, I., et. al. (2021). Traditional methods of assessing fish freshness, such as sensory evaluation and chemical tests, are often subjective and time-consuming. In recent years, advancements in computer vision and deep learning have opened up new possibilities for automated and objective freshness assessment (Tolentino, L. K. (2017).

Deep learning, a subset of artificial intelligence, has demonstrated remarkable success in various image and video analysis tasks. By leveraging deep neural networks, such as convolutional neural networks (CNNs), it is possible to extract intricate patterns and features from visual data. In the context of fish freshness assessment, deep learning models can analyze images of fish, capturing subtle changes in color, texture, and other visual cues that indicate deterioration (Diamante, R. et. al. (2020).

Several studies have explored the application of deep learning to fish freshness detection (Pellegrino, R. V., et. al (2024). For instance, Al-Ghiffary et al. (2023) proposed a CNN-based model using the

ResNet50 architecture to classify milkfish into fresh and not-fresh categories, (Mahendran, R., & Seneviratne, G. P. (2022). Their model achieved promising results, demonstrating the potential of deep learning for accurate and efficient freshness assessment. Another study by Abu Rayan et al. (2021) utilized a combined deep learning model, incorporating VGG-16 and Bi-directional Long Short-Term Memory (BiLSTM) networks, to classify fish freshness with high accuracy.

By developing and deploying deep learning models, it is possible to automate the process of fish freshness classification, Aguil, A. J. C., et.al. (2018). reducing the reliance on human judgment and improving the overall quality control in the seafood industry. This technology can help ensure that consumers receive fresh and safe seafood products while also optimizing supply chain management and reducing food waste.

This study sought to create a CNN-based deep learning model to efficiently determine the freshness of milkfish (*Chanos chanos*) through a non-destructive approach. The study aimed to design and develop a mobile app that capable of classifying the freshness of milkfish based on visual image analysis.

II. METHODOLOGY

The Conceptual Framework of the Study

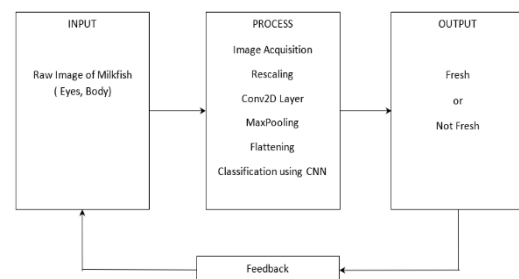


Figure 1 – The Conceptual Framework of Development of Mobile App in Detecting Milkfish Freshness using CNN

In Figure 1, the process begins with the application using the camera to capture an image of the

milkfish. The next steps involve image acquisition, followed by passing the image through a series of convolutional neural network (CNN) layers. First, the image is re-scaled to match the model's required dimensions. Then, the image undergoes feature extraction through a Conv2D layer, followed by a MaxPooling layer for dimensionality reduction. A Flattening step prepares the data for classification. The final step involves classifying the image using the CNN, and the application outputs a result that categorizes the milkfish as either 'fresh' or 'not fresh.'

Project Description

The mobile app uses a deep learning model to detect the freshness of milkfish (*Chanos chanos*) through image classification. Users can simply take a photo, and the app will instantly classify the fish as "Fresh" or "Not fresh." It operates offline as a standalone application, delivering fast and reliable results without the need for internet or server access.

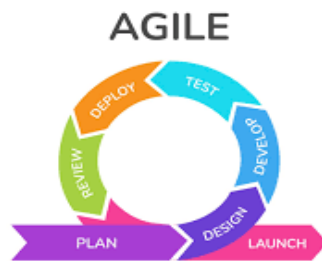


Figure 2 – The Agile Model

Planning

The researchers establish a clear understanding of the problem they aim to address—classifying the freshness of milkfish without the need for physical contact, such as touching or smelling the fish. By moving away from traditional methods, the goal is to create an application that offers a more convenient and efficient way for users to assess milkfish freshness using their mobile devices.

System Design

The researchers created several types of UML diagrams to better understand the system's behavior and structure of the Milkfish Freshness Detection application, helping to ensure a well-organized and efficient development process.

Development

The researchers utilized Android Studio as their Integrated Development Environment (IDE) for developing the application. Android Studio is a powerful tool specifically designed for Android app development, which supports building, testing, and debugging Android apps. In this case, the researchers used it to create the app's user interface, integrate the

app's functionalities, and ensure it ran smoothly on Android devices.

For the programming language, the researchers chose Java, a widely-used, object-oriented language that is commonly employed for building Android applications.

Furthermore, the researchers used Python to train a machine learning model that would be integrated into the application. They leveraged Google Colab, a cloud-based platform that allows for easy and collaborative model training without requiring local computing resources. The model was trained using datasets of milkfish images to detect freshness based on visual characteristics, and then exported to be deployed within the Android app.

Testing

During this phase, the researchers focused on testing the application's performance and user-friendliness using the Android Studio Emulator. The researchers wanted to make sure that when users use Freshness Detection to assess the freshness of milkfish, they get accurate and reliable results. By thoroughly testing the application, the researchers aimed to improve its overall quality and make it a valuable tool for users.

ISO 25010:2011 model was used to assess the "Development of Mobile app in detecting Milkfish Freshness using CNN." It was utilized for testing and assessment for the user's perception.

Deployment

The application will be deployed only after all functionalities have been tested and secure deployment process have been implemented. Ensuring that the Freshness Detection of Milkfish application reached its target audience and provided a valuable tool for assessing fish freshness, promoting food safety, and supporting sustainable fisheries practices.

Maintenance

Focuses on assessing whether the application meets its design and functional requirements. This includes testing its functionality and usability. The researchers collected user feedback to gain insights into their experience with the Milkfish Freshness Detection app.

III. RESULTS AND DISCUSSION

The model shows good performance with a precision of 99.26%, recall of 99.25%, and an F1 score of 99.25%, indicating it predicts positive samples and has a good balance between precision and recall. The overall accuracy is 98.49%, with a relatively low loss of 0.2511, suggesting the model is making small prediction errors. In short, the model is performing very well.

The evaluation results indicate that the developed system for assessing milkfish freshness is highly functional across various quality attributes, as assessed using ISO 25010:2011 standards.

Table 1 – The Overall Summary of Systems Performance

Criteria	Mean	Interpretation
Functional Suitability	3.8	Very Functional
Performance Efficiency	3.6	Very Functional
Usability	3.7	Very Functional
Reliability	3.3	Moderately Functional
Security	3.5	Very Functional
Maintainability	3.5	Very Functional
Portability	3.6	Very Functional
Compatability	3.5	Very Functional
Overall Mean	3.6	Very Functional

The overall mean score of 3.6, interpreted as "Very Functional," suggests that the system effectively meets user needs and performs reliably in practical applications. Among the individual criteria, Functional Suitability (3.8), Performance Efficiency (3.6), Usability (3.7), Security (3.5), Maintainability (3.5), Portability (3.6), and Compatability (3.5) all received ratings indicating that the system is well-designed, user-friendly, and adaptable across different environments. These high scores suggest that users found the system effective in classifying milkfish freshness, easy to use, and secure, with the potential for updates and deployment across various platforms. However, Reliability (3.3) was rated as "Moderately Functional," indicating that while the system is generally dependable, there may be occasional inconsistencies in performance. This suggests opportunities for improvement, such as optimizing the model's accuracy, refining error handling, and enhancing system stability under varying conditions.

Overall, the results confirm that the system is a robust and practical tool for milkfish freshness assessment, with minor areas for refinement to further enhance reliability and user experience.

CONCLUSIONS

The researchers explores a non-destructive method for detecting the freshness of milkfish (*Chanos chanos*) using image processing techniques. The study focuses on analyzing specific features of the fish's eyes and body tissues. These features are extracted after segmenting the relevant areas from the background image. The extracted features are then fed into a convolutional neural network (CNN), a type of artificial intelligence skilled at image recognition.

The system achieved an impressive accuracy of 90% in classifying milkfish as fresh or not fresh. This finding suggests that the method has significant potential for various stakeholders in the fish industry, including vendors, growers, and consumers.

RECOMMENDATIONS

The researchers believe that this method has the potential to be applied to other fish species with further investigation. Moreover, they recommend enhancing the approach by incorporating advanced image processing techniques, expanding the dataset to include invalid images, and considering various backgrounds and lighting conditions. Furthermore, testing the system with different cellphone cameras and resolutions would contribute to improving its overall performance and adaptability.

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