UNIVERSITI TEKNOLOGI MARA

JIIICaS 2024
JOHOR INTERNATIONAL INNOVATION, INVENTION COMPETITION AND SYMPOSIUM

PROCEEDINGS OF JOHOR INTERNATIONAL INNOVATION INVENTION COMPETITION AND SYMPOSIUM 2024 (JIIICaS 2024)

"Flourish and Nurturing Sustainable Innovation for a Prosperous Nation"

JIICOS 2024
JOHOR INTERNATIONAL INNOVATION, INVENTION COMPETITION AND SYMPOSIUM

Editorial Board

e ISBN: 978-967-0033-25-9

Published in Malaysia by
Universiti Teknologi MARA Cawangan Johor
Kampus Pasir Gudang
81750 Masai

Preface

In the name of Allah, the Almighty who gives us the enlightenment, the truth, the knowledge and with regards to Prophet Muhammad (peace be upon him) for guiding us to the straight path. We thank to Allah for giving us guidance and strength to write this e-book.

This e-book compiles the extended abstracts that submitted to Johor International Innovation Invention Competition and Symposium 2024 (JIIICaS2024), where JIIICaS2024 is a virtual platform for all creative minds to share and present their invention and innovation. Each abstract gives a brief background on the innovation or project.

We hope that this e-book will help the readers to get to know the innovation done by the students and get some ideas to develop future innovation products.

Foreword Rector

Assalamualaikum warahmatullahi Wabarakatuh, Salam Sejahtera, Salam Malaysia MADANI and Salam UiTM Dihatiku.

In the name of Allah, the Most Gracious, the Most Merciful.

It is a great honor to welcome you to the Johor International Innovation, Invention, Competition, and Symposium 2024 (JIIICaS 2024). This event connects various disciplines, focusing on education and engaging educators, students, researchers, and innovators from all walks of life.

Innovation is not just about ideas; it demands perseverance, creativity, and determination to turn those ideas into reality. The remarkable projects showcased today highlight the dedication and spirit of all participants. Initiatives like this not only explore new technologies but also cultivate skills and leadership among our youth. At Universiti Teknologi MARA (UiTM) Johor Branch, we are fully committed to fostering a dynamic culture of innovation, promoting the commercialization of new products, and encouraging meaningful collaborations with industry and society.

As we celebrate this event, I would like to extend my heartfelt gratitude to all sponsors, judges, the College of Computing, Informatics and Mathematics, UiTM Pasir Gudang Campus as the event organizer, as well as to the researchers and participants for their hard work in making this event a success. Let us continue striving for innovation and excellence. May the ideas presented today inspire us and lay the groundwork for future achievements.

Thank you.

Associate Professor Dr. Saunah Zainon
Rector
Universiti Teknologi MARA (UiTM)
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(A-ST019) FISH DISEASE DETECTION USING CONVOLUTIONAL NEURAL NETWORK (CNN) ALGORITHM

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ABSTRACT

Effective disease detection in aquaculture is crucial for maintaining fish populations and promoting best practices. Traditional methods often rely on visual inspection alone, which can lack precision and efficiency. This study introduces a fish detection system that leverages Convolutional Neural Networks (CNNs) and advanced image processing techniques, with a flexible, iterative research approach guiding its development. The CNN model, selected through algorithmic analysis, achieves an impressive 88.04% accuracy in automatically identifying and diagnosing various fish diseases. Trained on diverse datasets, the model can discern key features from fish images. An intuitive software application is then developed for aquaculture professionals, enabling rapid and accurate disease diagnosis. This approach marks a significant advancement in applying machine learning for disease management in aquaculture, overcoming the limitations of manual observation and contributing to the sustainable future of fish farming.

Keywords: fish disease detection, cnn, convolutional neural network, aquaculture

1.0 INTRODUCTION

The aquaculture industry plays a crucial role in providing primary protein sources, driving global economic growth, and ensuring food security (Yasruddin et al., 2022). As the global population expands and the nutritional value of fish as a protein source gains widespread recognition, the demand for fish resources continues to rise (Yasruddin et al., 2022). However, the industry faces significant challenges, particularly in managing disease outbreaks among fish. Traditionally, diagnosing fish diseases has relied on expert assessments, which can be labor-intensive and prone to human error. This can lead to substantial financial losses for stakeholders, such as fish farmers, who are already grappling with issues like bacterial and fungal infections, as well as environmental pressures (Waleed et al., 2019).

Subsequently, diagnosing fish diseases is a complex task that demands a high level of expertise, and existing systems for disease detection have yet to achieve significant success. Early identification of diseased fish is crucial to prevent the spread of illness (Malik et al., 2017). The University Putra Malaysia's Institute of Bioscience emphasizes the need for increased collaboration among scientists, fish farmers, and other stakeholders to understand better and manage fish diseases, thereby addressing the growing demand for fish as a food source (Azman Zakaria, 2017). In response to this challenge, developing advanced and precise detection methods, such as Convolutional Neural Networks (CNNs), holds promise. CNNs, with their capability to recognize intricate patterns and features in images, can significantly enhance the accuracy of fish disease identification and

classification. This technology can aid aquaculture stakeholders, including fish farmers and researchers, in minimizing losses, ensuring fish health, and improving production by enabling early detection and prompt treatment. Thus, utilizing CNNs for fish disease detection is proposed as a valuable research project.

2.0 OBJECTIVE

This research aims to develop an advanced system for detecting fish diseases in aquaculture using Convolutional Neural Networks (CNNs). The primary objectives of the project are threefold. First, studying the Convolutional Neural Networks (CNNs) algorithms in identifying fish diseases within an aquaculture setting. Second, the project will focus on designing and building a prototype system that utilizes CNNs for disease detection in fish. Finally, the accuracy of the CNN-based system will be evaluated to ensure its reliability and effectiveness in diagnosing fish diseases. Through these objectives, the project intends to enhance disease detection methods, ultimately supporting the health and productivity of aquaculture operations.

3.0 METHODOLOGY

The research on fish disease detection using CNN follows the CRISP-DM (Cross-Industry Standard Process for Data Mining) framework, which is a standard approach for data mining projects. This framework has six phases: business understanding, data understanding, data preparation, modeling, evaluation, and deployment (Surhone, 2010).

The first phase, business understanding, defines project goals and identifies challenges in fish disease management. The data understanding phase involves collecting relevant images of diseased fish. For this study, the dataset of 300 images from Kaggle, provided by the Bangladesh Fisheries Development Corporation (BFDC), is split into training and testing sets in a 70:30 ratio. Details of the data are in Table 1.

Table 1: Details of the data used in this research.

Data Type	Secondary data
Source	Kaggle website
Number of Datasets	Total Dataset: 300 data Training dataset (70%): 210 data Testing dataset (30%): 90 data

The data preparation phase is crucial for making sure the collected images are ready to train the CNN model. This phase involves five main steps: image resizing, image normalization, data augmentation, dataset splitting, and labeling. In the resizing step, all images are adjusted to a standard resolution of 256 x 256 pixels to ensure computational efficiency. Next, pixel values are normalized to a common range. To prevent overfitting and improve model robustness, data augmentation techniques are applied. After these steps, the dataset is split into training and testing sets, with 70% of the images used for training and 30% for testing. The core of this research is designing and implementing a CNN model for fish disease detection, which includes three key stages: architecture design, training, and evaluation. The figure below illustrates the architecture of this fish detection system.

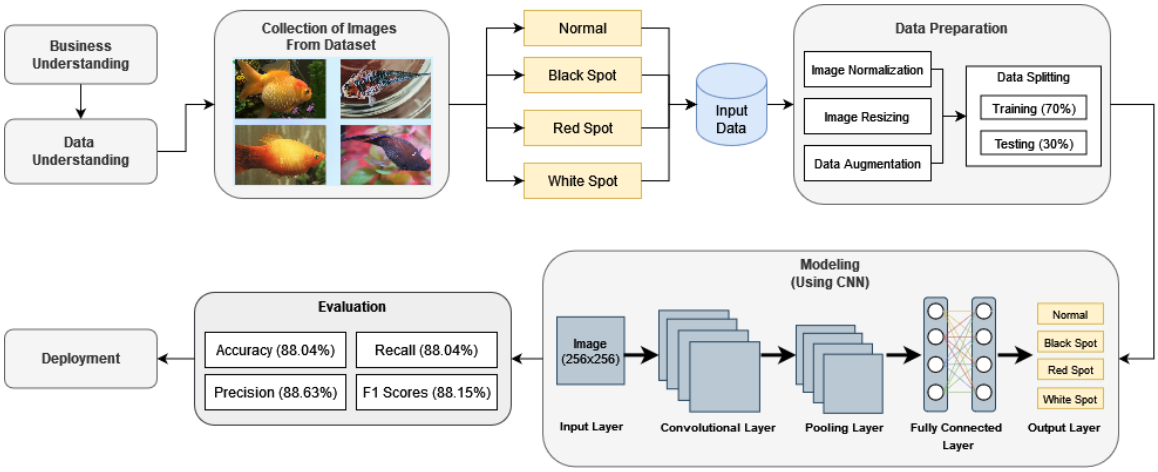

Figure 2: Architecture design of this fish detection system.

In the evaluation phase, the trained CNN model is evaluated on the test dataset to determine its effectiveness in detecting fish diseases. Key evaluation metrics are analyzed, including confusion matrices and classification labels. The last phase, deployment, involves integrating the model into a user-friendly application or system that fish farmers can utilize for real-time disease detection.

4.0 RESULTS

The implementation of the CNN for fish disease detection yielded promising results, both in terms of model performance and user interface functionality. In terms of user interface, the system was designed to be intuitive and user-friendly, facilitating easy integration into the daily operations of fish farmers. The interface allows users to upload images of fish, which are then processed by the CNN model for disease detection. The results are displayed in real-time, with clear textual labels of the detected disease. This design aims to provide immediate feedback and actionable insights, enabling users to make informed decisions quickly. The interface of the system is shown in the figure below (refer to Figure 3).

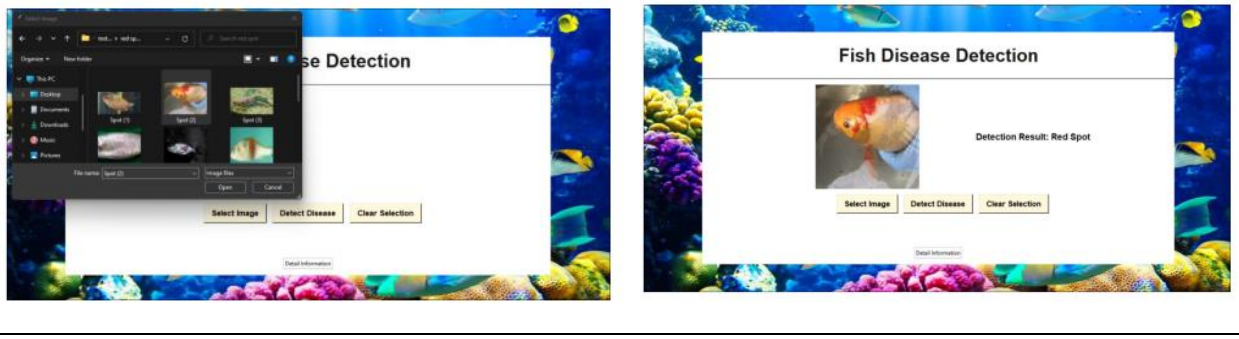

Figure 3: Interface of the system

For the model performance, the CNN model demonstrated a high level of accuracy in classifying fish images into four disease categories (Normal, Black Spot, Red Spot, and White Spot). Specifically, the model achieved an overall accuracy of 88.04% on the test dataset, with precision, recall, and F1 scores of 88.63%, 88.04%, and 88.15%, respectively, indicating strong performance across different disease classes. These results, refer to Table 2, highlight CNN's capacity to accurately distinguish between healthy and diseased fish, thereby reducing the risk of misclassification and supporting effective disease management.

Table 2: Result of the model performance

Evaluation Test	Result
Precision	88.63%
Recall	88.04%
F1 Score	88.15%
Accuracy	88.04%

The results are then summarized in a confusion matrix, which provides a comprehensive understanding of how well the model classified the data into the four categories (refer to Figure 4).

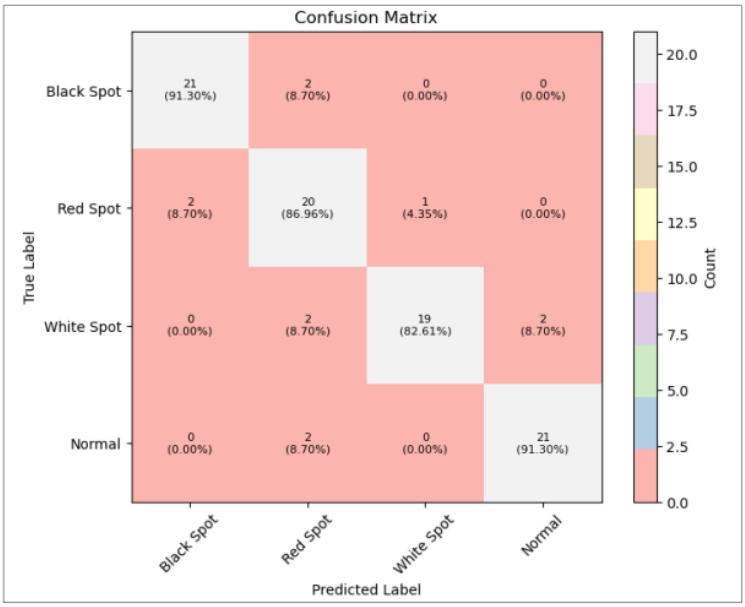

Figure 4: Confusion matrix of this research

In the Black Spot category, the model correctly identified 21 instances, achieving a high accuracy of 91.30%. However, there were 2 cases where Black Spot was misclassified as Red Spot, accounting for 8.70% of the instances. For the Red Spot category, the model accurately detected 20 instances, resulting in an 86.96% accuracy. There was also 1 instance where Red Spot was incorrectly predicted as White Spot, leading to a 4.35% error rate. Additionally, 2 instances of Red Spot were mistakenly classified as Black Spot, which makes up 8.70% of the cases. In the White Spot category, the model correctly identified 19 cases, yielding an accuracy of 82.61%. However, 1 instance of White Spot was misclassified as Red Spot, resulting in a 4.35% error rate, and White Spot was confused with Black Spot in 3 cases, accounting for 13.04% of the instances. For the Normal category, the model accurately classified 21 instances, corresponding to a 91.30% accuracy. However, there were 2 cases where Normal was incorrectly labeled as Red Spot, contributing to an 8.70% misclassification rate. Overall, the confusion matrix indicates that the model performs relatively well across all categories, with accuracy percentages ranging from 82.61% to 91.30%. However, there are still some misclassifications, particularly between similar disease categories like Red Spot and White Spot or Black Spot and Red Spot. These errors could be due to overlapping symptoms or visual similarities between different diseases.

5.0 CONCLUSION

The research developed a Convolutional Neural Network (CNN) model for detecting fish diseases, specifically targeting Black Spots, Red Spots, White Spots, and Normal conditions. The primary objective was to provide an accurate, efficient, and automated solution for disease detection, aiming to reduce reliance on manual inspection and mitigate financial losses in the aquaculture industry. The CNN model demonstrated commendable accuracy, ranging from 82.61% to 91.30%, with particularly high performance in identifying Black Spots and Normal conditions. However, some challenges were noted, particularly in distinguishing between Red Spots and White Spots. To address these issues, future enhancements could include expanding the dataset to include a broader range of examples, refining the model through fine-tuning, and incorporating additional pre-processing techniques to improve classification accuracy. The impact of this research on the aquaculture industry could be substantial. By offering a tool for timely and precise disease detection, the model could significantly enhance fish health management practices and reduce economic losses associated with disease outbreaks. Future research should focus on refining the CNN model by diversifying the dataset, optimizing the network architecture, and exploring additional data sources to further enhance accuracy and reliability. This study underscores the potential of CNNs as powerful tools for advancing fish disease detection and promoting the sustainability of aquaculture practices.

6.0 REFERENCE

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