Fish Disease Detection Using Machine Learning

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Abstract- **Aquaculture plays an important role in global food production,and economic growth but it is highly vulnerable to the outbreak of diseases that can cause significant economic losses and ecological damage.Manual disease detection is labor-intensive, time-consuming, and often inaccurate results due to the subtlety of early symptoms. This project presents an automated fish disease detection system using (CNN) with Python and flask to identify and classify common fish diseases based on image data. The system enables users to upload fish images through a web-based interface, where the model analyzes visual symptoms such as lesions, discoloration, and abnormal growths.It accurately and efficiently identifies potential diseases and provides appropriatetreatment recommendations to the required user who interact with the system. This automated approach facilitates early disease detection, reduces fish mortality, and minimizes reliance on chemical treatments. The system is cost-effective, user-friendly, and scalable, offering an advanced technological solution to improve fish health monitoring and promote sustainable aquaculture practices.**

Keywords: **Fish Disease Detection, Convolutional Neural Networks (CNNs), Aquaculture, Image Analysis, Automated System.**

I. INTRODUCTION

Fish farming is a crucial component of global food production and provides a major source of protein to meet the increasing demand of the growing population. However, a fish disease outbreaks remain a significant challenge, causing severe economic losses, reduced fish production, and environmental degradation.Diseases triggered by bacteria, viruses, fungi, and parasites can spread rapidly if not detected early, making timely diagnosis essential to prevent large-scale losses in the entire aquaculture development.Manual observation requires expert knowledge and continuous monitoring, which is impractical for large-scale fish farms. Laboratory-based diagnosis, though reliable, is costly and often inaccessible to small-scale fish farmers. These limitations increase the risk of delayed detection, resulting in widespread infections and compromised fish populations.

For this purpose, to address these challenges, this project proposes an automated Fish Disease Detection system utilizing Convolutional Neural Networks (CNNs) implemented using Python and the Flask framework. CNNs have shown remarkable effectiveness in image-based classification tasks.

Machine learning (ML) offers a powerful alternative by leveraging advanced algorithms to analyze patterns in fish images, water quality parameters, and other biological indicators. By training models on large datasets, ML can detect diseases at an early stage, enabling timely intervention and reducing mortality rates. This study explores the application of machine learning techniques such as Convolutional Neural Networks (CNN), Support Vector Machines (SVM), and Decision Trees for automated fish disease detection. The proposed system (CNN) convolutional Neural Network aims to improve accuracy, reduce dependency on human expertise, and enhance overall fish health management in aquaculture where the CNN model processes the images and provides real-time diagnostic feedback along with treatment recommendations. The system is designed to be user-friendly, enabling fish farmers to access reliable disease detection without requiring specialized technical knowledge.

II. LITERATURE SURVEY

"Fish Diseases Detection Using Convolutional Neural Network (CNN)"by Noraini Hasan et al.proposes a machine learning technique based on Convolutional Neural Networks (CNN) for identifying and categorizing fish diseases into Healthy, White spot, and Red spot. The study used 90 images as input for the CNN model and tested 36 images to evaluate performance using accuracy,

sensitivity, and specificity metrics. The findings show that CNN is effective, with mean accuracy of 91.67%, sensitivity of 94.44%, and specificity of 97.2%.Overall, the article confirms that CNN models are reliable for fish disease detection. Future research should focus on expanding datasets and improving model architecture.

"Fish Disease Detection Using Deep Learning and Machine Learning" by MdRashedul et al. compares deep learning and machine learning techniques for fish disease detection. The authors created a new dataset of 1,382 images by combining multiple sources. The research compared machine learning and deep learning models, concluding that deep learning offers superior performance. Among the models tested, ResNet50 performed well, but the ensemble model combining VGG16 and VGG19 achieved the best results, surpassing ResNet50 in accuracy. The study highlights the need for larger, more diverse datasets and suggests future work should focus on dataset expansion, advanced segmentation techniques, and applying more deep learning models. It also recommends developing web-based or mobile applications for practical fish disease detection.Overall, the article demonstrates that deep learning, particularly ensemble models like VGG16+VGG19, is highly effective for fish disease detection and suggests future improvements through dataset expansion and application development.

"Feasibility Study of Fish Disease Detection Using Computer Vision and Deep Convolutional Neural Network (DCNN) Algorithm" by Yasruddin et al. explored automatic fish disease detection using computer vision and a deep convolutional neural network (DCNN) algorithm. It used 1200 fish images categorized as diseased or healthy, based on expert classification. The DCNN classifier achieved a mean average precision (mAP) of 0.237, indicating that integrating computer vision with DCNN can effectively detect fish diseases. This research emphasizes the need for automated systems to reduce human error and improve early disease detection in the aquaculture industry. A mAP of 0.237 suggests that while the model can detect fish diseases, there is room for improvement. In general, higher mAP values indicate better detection accuracy, with values closer to 1.0 being ideal. This result, though not highly precise, is reasonable given the complexity of fish disease classification and the limited availability of well-labeled datasets. Future work could focus on optimizing the model architecture, increasing dataset diversity, and using advanced techniques to improve the mAP score for more reliable disease detection.

"A Convolutional Neural Network Approach for Precision Fish Disease Detection" by Dr. Mihaira H. Haddad, Fatima Hassan Mohammed studies deep learning techniques, specifically CNNs, to automate the detection of various fish diseases using image data. The research utilized a curated dataset from the Kaggle database, encompassing images of seven distinct fish diseases and healthy specimens. The CNN model demonstrated high accuracy and balanced precision and recall values across multiple disease categories.

2.1 Existing System

In traditional fish farming, disease detection primarily relies on manual observation by experts or farmers. This method is time-consuming, requires extensive expertise, and is prone to human error. Often, farmers recognize diseases only after severe symptoms appear, leading to delayed treatment and higher losses. Moreover, laboratory-based diagnosis, while accurate, is expensive and not always feasible for small-scale fish farmers. Due to these limitations, many fish diseases go undetected until they become widespread, affecting entire fish populations.

III. PURPOSES OF WORK

The objective of this project is to develop an intelligent Fish Disease Detection System using Convolutional Neural Networks (CNNs) to accurately and efficiently classify fish diseases from images of a dataset. The system is designed to extract key visual features from fish images, differentiate between healthy and diseased fish, and classify various types of infections with high accuracy.

By implementing a real-time and scalable detection framework, this project seeks to assist fish farmers and aquaculture industries in early disease identification, reducing economic losses, and improving fish health management.The primary objective of this project is to develop an AI-driven fish disease detection system using Convolutional Neural Networks (CNNs) to automate and enhance

the accuracy of disease identification in aquaculture. The system is designed to address the challenges faced by traditional manual detection methods, which are time-consuming, subjective, and prone to errors.

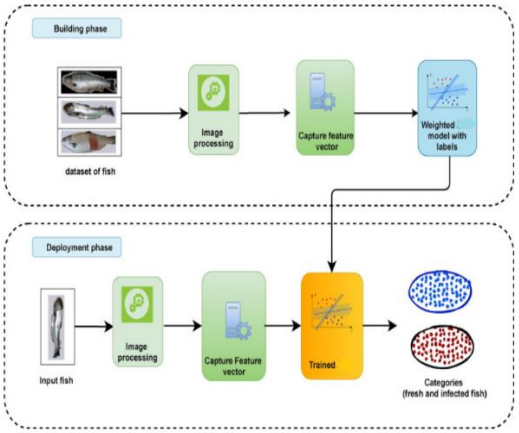
Additionally, the system aims to improve fish health management by offering a user-friendly platform where farmers can upload fish images for instant diagnosis. By integrating deep learning with aquaculture, the project seeks to enhance food security, optimize fish farming efficiency, and support environmental sustainability through proactive disease control measures.

IV. METHODOLOGY

It begins with the collection of a diverse dataset containing images of fish infected with various diseases. The purpose of using CNNs in the fish disease detection system is to automate the feature extraction and classification process, eliminating the need for manual intervention and expert knowledge during diagnosis. CNNs can learn complex patterns from large datasets and distinguish between healthy fish and fish affected by various diseases. The images are carefully labeled with disease categories, such as fin rot, dropsy, fungal infections, and others, ensuring the dataset captures different fish species, growth stages, and environmental conditions.

ACNN architecture is then designed, typically consisting of multiple convolutional layers, pooling layers, and fully connected layers to automatically learn discriminative features from the images. The model is trained on the preprocessed dataset using a suitable loss function and optimizer to minimize classification errors.and efficient solution for real-time monitoring in aquaculture.

System Architecture:
An architecture description is a formal description of a system, organized in a way that supports reasoning about the structural properties of the system. It defines the system components or building blocks and provides a plan from which products can be procured, and systems developed, that will work together to implement the what overall system



V. PROPOSED WORK

The proposed system using machine learning and image processing to automated fish disease detection. Using a trained convolutional neural network (CNN) model, the system to be analyze uploaded fish images and classifies them into different disease categories. The Flask framework provides an intuitive web interface where users can interact with the system seamlessly. The model is trained on a dataset containing images of healthy and diseased fish, allowing it to recognize patterns and symptoms with high accuracy. Additionally, the system suggests preventive measures and possible treatments based on the detected disease, aiding farmers in making informed decisions to the user. This approach enhances efficiency, minimizes losses, and promotes sustainable aquaculture practices.

VI. MODULES

Image Upload and Preprocessing: Users upload images of fish through the web application. The system preprocesses the images byresizing, filtering noise, and enhancing relevant features for better classification.
Feature Extraction and Model Prediction: The CNN model extracts significant features such as skin texture, color variations, and lesions. It then segments the fish as healthy or diseased and identifies the specific disease if detected.
Disease Identification and Recommendations: Based on the classification, the system provides detailed information about the disease, including symptoms, causes, and preventive measures. It also suggests appropriate treatment methods.
Web-Based Interface: The Flask-based web application offers a user-friendly dashboard where

farmers can upload images, view results, and access disease management guidelines.
Database and Learning Enhancement: The system maintains a database of previously analyzed cases, allowing continuous learning and improvement of the detection model over time.

VII. RESULTS AND CONCLUSION

CNN-based fish disease detection offers substantial social benefits for fish farmers, the aquaculture industry, and consumers. Early disease detection mitigates mass fish mortality, ensuring a stable food supply and safeguarding the livelihoods of small-scale farmers.Machine learning with Python for fish disease detection holds significant promise for revolutionizing the aquaculture industry.

However, successful implementation may require training and awareness programs to familiarize farmers with AI-driven technology. Support from government agencies and industry stakeholders can facilitate broader adoption, ensuring the solution is accessible to both small-scale and large-scale fish farming operations. Overall, the system aligns with societal goals by enhancing food security, improving public health, and supporting sustainable aquaculture practices.

The development of a web-based interface ensures that users can easily interact with the system, facilitating real-time monitoring and decision-making. Additionally, the incorporation of a dynamic database and learning enhancement module allows the system to continuously improve and adapt to new diseases or changing environmental conditions.

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