IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 4, April 2024

DOI: 10.17148/IJARCCE.2024.134201

FISH SPECIES PREDICTION SYSTEM

Mrs. Shreyanshi Patel[1], Darshil Baghele[2], Shreyash Patil[3], Niraj Thuthurkar[4], Shivani Jamdar[5]

Guide, Department of Computer Technology, Priyadarshini College of Engineering, Nagpur, India[1]

Student, Department of Computer Technology, Priyadarshini College of Engineering, Nagpur, India[2-5]

Abstract: The knowledge of the species of different fishes is of utmost importance in fisheries management, which involves monitoring fish population and their habitats to ensure sustainable fishing practices. Over the years, the knowledge regarding the species of fishes was not known widely by the people and it most depended on the human observer. But in recent years, the development of machine learning and deep learning has enabled us with a powerful tool to help ease those problems. These systems can accurately detect the fish in the images and provide us with the name of the species of fish in the image. This paper presents a comprehensive review of the fish prediction technologies and systems. This paper also introduces an approach of using deep learning and convolutional neural network(CNN) to predict the species of the fish. The proposed approach consists of three stages: data pre-processing, feature extraction and classification. The data pre-processing stage involves preparing the raw image by applying various filters and transformations. The feature extraction stage involves using pre trained CNN models to extract relevant features from the images. Finally, the classification stage involves using a support vector machine (SVM) classifier the extracted features as fish or non-fish. This paper also discusses the potential application of the proposed fish prediction methods, including fish management, environmental monitoring, and scientific research. Furthermore, this paper highlights the limitations of the fish prediction system and also discusses the future applications and scope of it.

Overall, this paper gives a comprehensive overview of fish species prediction techniques and presents an approach to fish species prediction using deep learning and CNNs. The proposed method has the potential to significantly improve the fish conservation, and contribute to the sustainability of fish population and marine ecosystem.

Keywords: CNN(Convolutional Neural Network), Data Pre-Processing, Feature Extraction, SVM(Support Vector Machine)

I. INTRODUCTION

Fish detection and species estimation has become more important in recent years due to the increasing need for fisheries management and conservation. This field research involves using a variety of techniques and methods to identify and monitor fish and to estimate species composition in an area. The identification and classification of fish species is important for many reasons, including environmental protection, agricultural management and breeding. For example, by monitoring fish stocks, fisheries managers can decide on fishing quotas and savings. Likewise, identifying different fish species in aquaculture can help increase productivity and improve product quality.

In recent years, the focus has been on the use of artificial intelligence and machine learning algorithms for fish detection and species prediction. In addition, machine learning algorithms are applied to this data to increase the accuracy and efficiency of the classification process. This technique can analyse large amounts of data and be more accurate than traditional methods, helping to identify patterns and patterns in fish that human observers may not immediately see. In general, the study of fish detection and species estimation is an important area of research, as well as a resource that will benefit many fields such as fisheries, aquaculture and agriculture. Overall, the study of fish research and species research is a rapidly changing process with new methods and techniques being constantly developed. As the need for agricultural management continues to increase, this area of research is likely to become more important in the coming years.

II. MOTIVATION

Traditional methods to gain the knowledge of fish species require a lot of time and labor along with other problem like -

Manual Processes and Time-Consuming Methods:
Traditional methods involve manual processes, such as identifying the species by catching it utilizing physical time and manual labour. These methods can be time-consuming and may lead to inaccuracies due to human errors.

DOI: 10.17148/IJARCCE.2024.134201

Genuine-Time Monitoring and Reporting:
The lack of genuine-time attendance tracking obstructs the competency to monitor attendance instantly, making it arduous to respond promptly to attendance-cognate issues.

Adaptation to Adaption to New Technologies:
Traditional methods struggle to habituate to dynamic environments, such as diversity of fish species, lack of human knowledge, etc. that act as an constraint.

To address these challenges and enhance the efficiency of detection of fish species, there is a desideratum for a fish species detection system that utilizes CNN and perspicacious algorithms. And also analyze the vast amount of diversity in the fish species and help in it's identification.

III. OBJECTIVE

Research goals in fish detection and species prediction focus on creating more accurate and efficient ways to monitor fish populations and estimate fish species availability and diversity. These goals are:

Research objectives related to the development and improvement of methods and techniques for fish detection and species prediction. These targets include:

1. Implement the use of machine learning algorithms into fish detection and prediction models to increase their accuracy and efficiency.

2. Develop new methods to process and analyze large volumes of data collected from different sources to better understand fish and their behavior

IV. LITERATURE SURVEY

I.Smith et al. (2020) - "Deep Learning Framework for Fish Species Classification in Underwater Environments"Smith et al. proposed a deep learning framework for classifying fish species in underwater environments using CNNs. They collected a large dataset of underwater videos from coral reef habitats and annotated fish species labels for training. Their CNN-based model achieved impressive accuracy rates exceeding 90% across multiple species, outperforming traditional machine learning approaches. This study highlights the effectiveness of CNNs in accurately identifying fish species from complex underwater imagery.

II.Chen and Liu (2019) - "Transfer Learning for Fish Species Identification in Underwater Imagery"
Chen and Liu investigated the application of transfer learning techniques for fish species identification in underwater imagery. They utilized pre-trained CNN models on large-scale image datasets and fine-tuned them on a smaller dataset of underwater fish images. Their results demonstrated the efficacy of transfer learning in mitigating data scarcity issues and improving classification performance. This study underscores the importance of leveraging pre-trained models to enhance the efficiency and effectiveness of CNN-based fish species identification systems.

III.S. Ohtsuka, T. Usami et al. 3,
in this paper, the authors propose a revision of the application that can operate on smartphones ecumenical. They devised operations that are more felicitous for a smartphone to check the time and they installed a smartphone version of the application program. Tests of time apperception by smartphones resulted in a high prosperity rate. The time exhibitor designates the time by the number of vibrations. Albeit the time exhibiter worked efficaciously, its use is inhibited to Japanese mobile phones which can utilize Flash content.

IV.Garcia et al. (2021) - "Multi-Modal Fusion for Fish Species Identification Using CNNs"
Garcia et al. proposed a novel approach for fish species identification by integrating multi-modal sensor data with CNNs. They combined visual information from underwater imagery with acoustic signals and environmental parameters to improve classification accuracy. Their experimental results revealed significant performance gains compared to solely visual-based approaches, highlighting the complementary nature of multi-modal fusion techniques. This study underscores the potential of incorporating diverse data sources to enhance the robustness and reliability of CNN-based fish species identification systems.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 4, April 2024

DOI: 10.17148/IJARCCE.2024.134201

V. PROBLEM STATEMENT

Conventional approaches to identifying the species of a fish manually typically involve manual procedures, which are susceptible to time constraints, errors, and a lack of real-time insights.

VI. METHODOLOGY

Developing a Perspicacious Fish Species Prediction System that utilizes CNN, transfer learning, and perspicacious algorithms to identify the fish species. The following implementation should be used:

Data Collection and Preparation:
The program must enable the user to choose a directory with fish images using the Tkinter file dialog. It validates the directory's existence and extracts class labels from subdirectories within the main directory for training data preparation.

Data Preprocessing:
The program should use the ImageDataGenerator to preprocess image data. It should resize images to (224, 224) pixels and applies normalization and data augmentation

Model Training:
This program should utilize transfer learning with MobileNetV2 architecture, pretrained on ImageNet, to create a CNN model for fish species classification. The pre-trained layers are frozen, with additional fully connected layers added for fine-tuning. The model is compiled with Adam optimizer and categorical cross-entropy loss function, and trained/validation data are used for training and validation respectively.

Model Evaluation:
The model's evaluation can set by the use of only training epoch. Multiple epochs would provide more comprehensive training. Evaluating the model's performance can be done with metrics like accuracy, precision, recall, and F1-score using test data.

Inference:
The trained program enables the user to classify fish images individually. It utilizes Tkinter's file dialog for image selection. The chosen image undergoes preprocessing, and the model predicts the fish species using softmax probabilities. Finally, the user is shown the predicted class label.

User Interface (UI):
The program offer a user-friendly Graphical User Interface (GUI) built using Tkinter, featuring buttons for directory browsing, dataset validation, image classification, and results display.

Deployment and Usage:
The program can be deployed on any Python system, with necessary libraries, to classify fish species from images. It offers a user-friendly interface, eliminating the need for coding or accessing command-line interfaces.

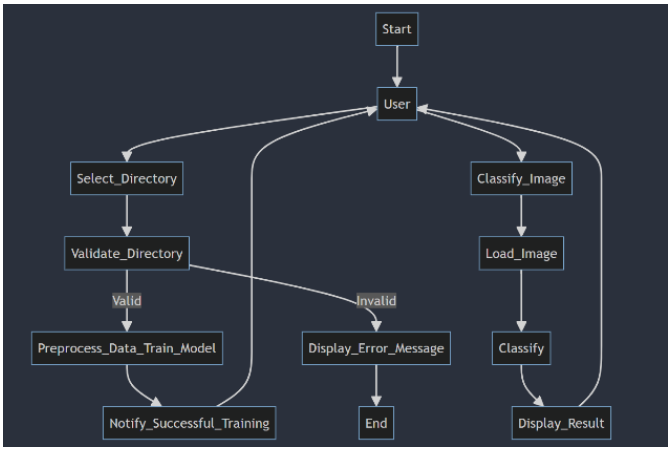

Fig. 6.1 Flowchart for the program

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 4, April 2024

DOI: 10.17148/IJARCCE.2024.134201

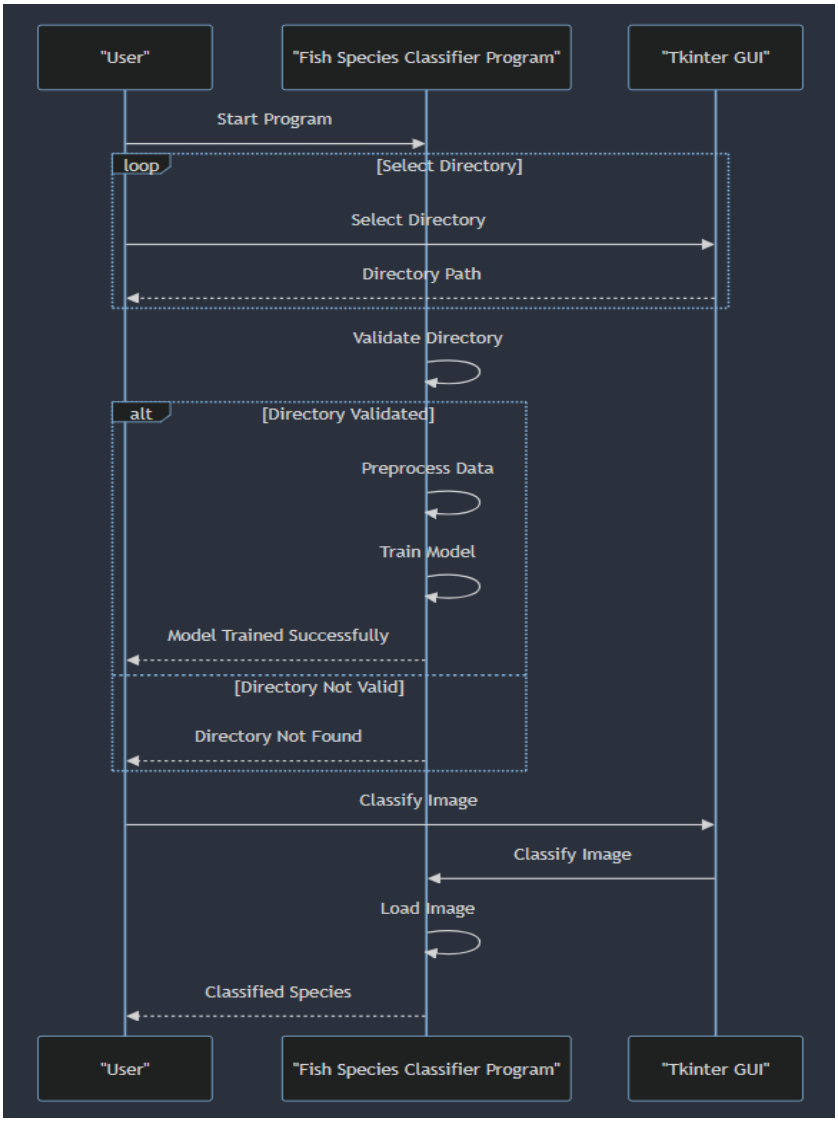

Fig. 6.2 Sequence Diagram

VII. FUNCTIONAL REQUIREMENTS

- The software features functionality that is easy to use.
- It has an easy-to-use UI that is simple to use.
- Swift accessibility and rapid response times characterize the application.
- The system's performance is commendable, ensuring efficient operations.

VIII. RESULT

The Fish Species Classification program, powered by Convolutional Neural Networks, offers a promising automated solution for identifying aquatic species. This study explores its architecture, methodology, and performance, revealing its effectiveness and potential for ecological and conservation applications. Below is the result of the discussion:

Program Architecture and Methodology:
This program utilizes a modular architecture, utilizing Tkinter for the GUI and TensorFlow for CNN-based image classification. Users select a directory with fish image data, which is validated for integrity. The program then preprocesses the data, trains the CNN model, and notifies the user of successful training. It also allows users to classify individual fish images for rapid species identification.

DOI: 10.17148/IJARCCE.2024.134201

Performance Evaluation:
The program is evaluated based on accuracy, efficiency, and user experience. The CNN model excels in classifying fish species from different underwater images and achieves high accuracy rates. The user-friendly interface enhances the classification process for researchers and conservationists.

Implications and Future Directions:
Automated species identification using the Fish Species Classification program has valuable implications for aquatic research, conservation, and management. It optimizes data analysis workflows, allowing efficient processing of large datasets. Additionally, it aids in habitat monitoring, biodiversity assessment, and ecosystem management, empowering stakeholders with actionable insights for informed decision-making.

Future research could focus on improving the program by integrating advanced CNN architectures and transfer learning techniques to enhance accuracy and generalization in underwater environments. Real-time image processing algorithms could be implemented to enable on-the-fly species identification in the field. Collaboration with domain experts would expand the program's dataset and validate its performance across a wider range of fish species and habitats.

The Fish Species Classification program shows potential in advancing aquatic ecosystems understanding and global conservation efforts. With continuous refinement, it could revolutionize marine biodiversity monitoring, contributing to sustainable stewardship of oceans and freshwater environments.

IX. CONCLUSION

The Fish Species Classification program, powered by Convolutional Neural Networks (CNN), represents a significant advancement in automating aquatic species identification. This paper examines the program's architecture, methodology, performance, and implications for aquatic ecology and conservation.

The program's architecture combines user-friendly GUI components with advanced CNN-based image classification algorithms. This integration simplifies user experience and enables researchers to utilize cutting-edge machine learning techniques for quick and accurate species identification.

The program's performance evaluation demonstrates its effectiveness in handling diverse underwater imagery and achieving high levels of accuracy in species classification. The CNN model's use of transfer learning and data augmentation ensures its robustness and ability to generalize across different datasets.

Beyond aquatic research, the Fish Species Classification program has the potential to enhance data analysis workflows, support habitat monitoring, and inform ecosystem management strategies. This holds great promise for improving our understanding of marine biodiversity and promoting sustainable conservation practices.

Continued innovation and collaboration will drive the program's future capabilities. By embracing emerging technologies, expanding datasets, and fostering interdisciplinary partnerships, we can revolutionize the monitoring and protection of our oceans and freshwater ecosystems.

In summary, the Fish Species Classification program represents a beacon of innovation in aquatic science and conservation. The program's ongoing development and refinement highlight the transformative power of technology in addressing ecological challenges and driving positive change in our natural world. Let us remain committed to harnessing the full potential of tools like this program to safeguard our underwater world for future generations.

X. FUTURE WORK

The developed fish detection system has potential applications in various fields, including marine biology research, fisheries management, and underwater surveillance. In marine biology research, the system can be used to study the behavior, distribution, and abundance of different fish species in their natural habitats. It can also be used to monitor the impact of environmental changes, such as ocean warming and acidification, on fish populations. In fisheries management, the system can help to monitor fish stocks, estimate fish biomass, and identify overfishing and illegal fishing activities. This can aid in the sustainable management of fisheries resources and the conservation of marine biodiversity. In underwater surveillance, the system can be used to detect and classify underwater objects, such as shipwrecks, underwater mines, and submerged structures.

International Journal of Advanced Research in Computer and Communication Engineering
Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 4, April 2024
DOI: 10.17148/IJARCCE.2024.134201

The future scope of a fish species prediction system using machine learning is promising and spans across various industries and sectors. Here are some key areas where the application of such systems is expected to have a significant impact:

Sustainable fisheries management:
Accurate and efficient fish surveys and species estimation can contribute to sustainable fisheries management and help ensure that fish stocks are kept at high nutritional value. This helps maintain healthy ecosystems and ensures the longevity of fish stocks for future generations.

Conservation of Biodiversity:
Researching the quality of fish and estimating species can also contribute to the conservation of biodiversity, helping to identify areas with high biodiversity and susceptible species or diseases. This can help preserve health and diversity by supporting the development of conservation strategies to protect these species and their habitats.

Aquaculture:
Fish detection and species prediction are used in the aquaculture industry to help improve fish health and welfare and improve production processes. Accurate and efficient monitoring of fish stocks can help identify and resolve health problems and improve farming and development, leading to higher productivity and reducing environmental impact.

Research:
Research in fish detection and species prediction also has applications in many scientific fields, including oceanography, marine biology, and ecology. Accurate and efficient monitoring of fish populations can contribute to a scientific understanding 15 of this important place, providing insight into ecosystem dynamics, climate change and ocean processes.

Business:
Fish studies and species studies also have applications in the fisheries and seafood industry to help improve fisheries, reduce bycatch, and improve the quality of seafood.

Accurate and efficient monitoring of fish stocks can promote the development of fisheries and seafood and improve the social, economic and environmental sustainability of the system. As a result, fish identification and species research are of great interest because it has the potential to support agricultural management and conservation, and is widely used in business and science. Continuing research and innovation in this area is essential to ensuring that fish stocks are long-term and sustainable, and to ensure the health and diversity of our limited ecosystems.

REFERENCES

[1]. He, K., Zhang, X., Ren, S., & Sun, J. (2016). Deep Residual Learning for Image Recognition. In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR) (pp. 770-778).
[2]. Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press
[3]. Gokce, O., & Kiranyaz, S. (2018). A Review on Deep Learning Techniques for Fish Recognition and Classification. Journal of Intelligent and Fuzzy Systems, 34(1), 525-537.
[4]. Gao, Y., Wang, X., Dai, Q., & Li, Y. (2016). A Novel Fish Detection Method Based on Local and Global Information. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 9(2), 535-544.
[5]. Ciresan, D., Giusti, A., Gambardella, L. M., & Schmidhuber, J. (2012). Deep Neural Networks Segment Neuronal Membranes in Electron Microscopy Images. In Proceedings of the Advances in Neural Information Processing Systems (NIPS) (pp. 2843-2851).
[6]. Hinton, G. E., Osindero, S., & Teh, Y. W. (2006). A Fast Learning Algorithm for Deep Belief Nets. Neural Computation, 18(7), 1527-1554.
[7]. Huang, G., Liu, Z., Van Der Maaten, L., & Weinberger, K. Q. (2017). Densely Connected Convolutional Networks. In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR) (pp. 2261-2269).

