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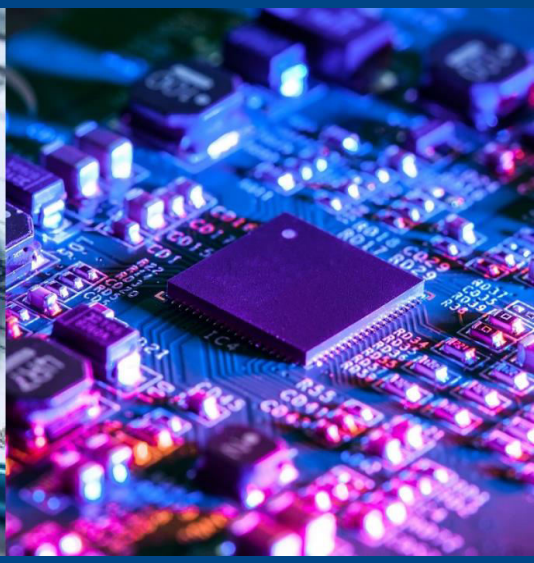

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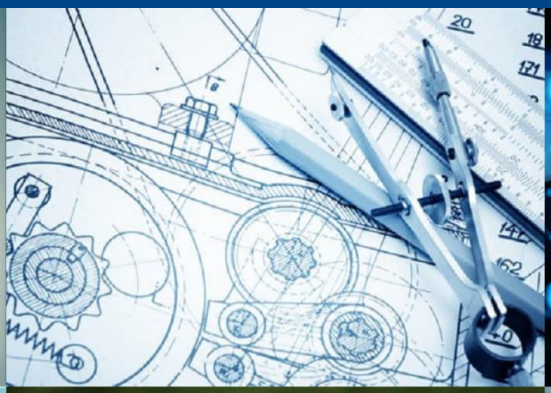

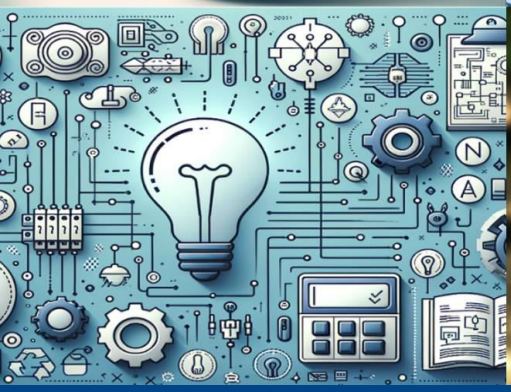

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Build a Smartphone App that uses a Neural Network to Identify the Fish and it's Origin

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ABSTRACT: This project aims to develop a smartphone app that uses a neural network to identify fish species, their origin, macronutrient content, advantages, and disadvantages. Users can take a photo of a fish against a predefined template, and the app will analyze the image using deep learning techniques. The neural network will be trained with a dataset of fish images and related information. The app will provide instant details about the fish, helping users make informed decisions about consumption and sustainability. This technology can be useful for consumers, nutritionists, and fish traders. The project combines machine learning, image processing, and mobile application development to create an accurate and user-friendly tool.

KEYWORDS: Fish identification, neural network, origin, macronutrients, advantages, disadvantages, image processing, mobile app

I. INTRODUCTION

Fish are an essential source of protein and nutrients for millions of people worldwide. However, identifying fish species accurately can be challenging for consumers, traders, and nutritionists who lack expert knowledge. Misidentification can lead to incorrect nutritional assumptions, health risks from toxic species, and illegal trading of endangered fish. To address this issue, this project aims to develop a smartphone application that uses a neural network to identify fish species, determine their origin, and provide details about their macronutrient content, advantages, and disadvantages. The app will allow users to take a photo of a fish against a predefined template, and the neural network will analyze the image to provide accurate and instant information. With advancements in artificial intelligence and deep learning, image recognition has become highly effective, making it possible to automate fish identification. The proposed app will utilize Convolutional Neural Networks (CNN), a deep learning model trained on a dataset of fish images, to classify species and retrieve relevant information. This approach eliminates the need for expert knowledge and ensures that fish identification is accessible to everyone.

The main objective of this project is to create an intelligent and user-friendly mobile application that simplifies fish identification while providing important nutritional insights. The app will not only recognize fish species but also determine their origin and nutritional composition, including protein, fat, and vitamin levels. Additionally, it will provide information about the advantages and disadvantages of consuming each species, helping users make informed dietary choices. The project will involve collecting and labeling a dataset of fish images, training a neural network model, and applying image processing techniques to improve accuracy. The mobile application will be designed with an intuitive interface, allowing users to capture fish images easily and receive real-time results. Extensive testing will be conducted to ensure the model's accuracy and reliability before deployment. This project integrates artificial intelligence and mobile technology to solve a real-world problem. By offering a fast and accurate fish identification system, the app will benefit consumers, traders, and nutritionists, promoting awareness and informed decision-making in the seafood industry.

II. LITERATURE REVIEW

The paper "Underwater Fish Species Recognition Using Deep Learning Techniques", likely aims to explore the use of deep learning methods to identify or classify various fish species from underwater images or video data. This could involve training a deep neural network on large datasets of labeled images to recognize different fish species and

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potentially improve the accuracy and efficiency of species identification, which has applications in marine biology, environmental monitoring, and conservation efforts[1].

The paper"Automatic Fish Species Identification Using Convolutional Neural Networks" is to develop an automated system for accurately identifying fish species using Convolutional Neural Networks (CNNs). By leveraging CNNs, the system aims to process and classify images of fish, allowing for rapid and precise identification without the need for manual intervention. The project focuses on improving classification accuracy, handling variations in image quality, and enhancing the system's ability to work with diverse aquatic species[2]. The outcome is expected to have significant applications in marine biology, environmental monitoring, and fishery management.

The aim of the paperr "An Improved Faster RCNN Marine Fish Classification Identification Algorithm" is to enhance the performance of fish species classification by applying an improved version of the Faster R-CNN (Region-based Convolutional Neural Network) algorithm. The project focuses on addressing challenges in marine fish identification, such as variations in fish appearance, lighting conditions, and underwater image quality[3]. By improving the Faster R-CNN framework, the authors aim to achieve higher accuracy and robustness in detecting and classifying marine fish species from images or video footage. The improved algorithm enhances the region proposal network (RPN) and feature extraction process, making it more efficient in identifying fish species in real-time applications. The project aims to provide an automated, scalable solution for marine biology, environmental monitoring, and fisheries management, reducing human effort and errors while improving the speed and reliability of fish species identification in complex underwater environments.

The paper "Fish Recognition Using Convolutional Neural Network" is to develop an efficient system for recognizing fish species using Convolutional Neural Networks (CNNs). The paper focuses on leveraging deep learning techniques, particularly CNNs, to automatically classify fish from underwater images[4]. The system is designed to handle the complexities of underwater environments, where fish appearances can vary due to factors like lighting, water turbidity, and motion. By training a CNN model on a large dataset of fish images, the paper aims to improve the accuracy and robustness of fish recognition, making it suitable for real-time applications. The research highlights the potential of CNNs to address the challenges in marine biology, such as species identification and biodiversity monitoring, without relying on manual or time-consuming methods. The outcome of this study is intended to provide a scalable solution for automated fish recognition in various ecological and conservation-related applications.

This paper developed to evaluate and compare the performance of various deep learning models in the task of classifying fish species from images. The study focuses on assessing different architectures, including Convolutional Neural Networks (CNNs) and other deep learning techniques, to determine their effectiveness in identifying fish species with high accuracy and efficiency. The authors aim to identify the strengths and limitations of each model, taking into account factors such as classification accuracy, computational complexity, and suitability for deployment in real-world applications, including environmental monitoring and marine biology research[5]. By conducting a thorough comparison of several models, the paper seeks to provide insights into the best-suited techniques for automated fish species recognition. The goal is to contribute to the development of robust, scalable, and reliable systems for fish classification, reducing human effort while ensuring high precision in identifying marine species.

The aim of the paper "Fish species identification using deep learning and underwater images" is to develop an automated system for accurately identifying fish species in underwater environments using deep learning techniques. This project leverages the power of convolutional neural networks (CNNs) to analyze and classify images captured from underwater cameras, which are often challenging due to factors such as varying lighting conditions, water clarity, and diverse species appearances[6]. The primary goal is to create a robust model that can reliably distinguish between different species based on visual features from these images, without the need for manual intervention.

It provide fish recognition, monitoring, and management" by J.G.A. Barbedo is to provide a comprehensive overview of how computer vision and artificial intelligence (AI) technologies are being applied to the fields of fish recognition, monitoring, and management. The paper reviews the various methodologies, algorithms, and tools used in these applications, highlighting their effectiveness and challenges. It discusses the role of AI techniques, particularly machine learning and deep learning, in improving the accuracy and efficiency of fish identification from images or videos, as well as their potential in monitoring fish populations and assessing marine ecosystems. Additionally, the paper

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emphasizes the importance of these technologies in supporting sustainable fisheries management and conservation efforts[7]. The goal is to shed light on the current state of the field and identify opportunities for further research and innovation in AI-based fish monitoring systems.

The paper aims to demonstrate the effectiveness of the VGG16 model in fish species recognition by evaluating its performance in terms of classification accuracy and computational efficiency. By utilizing a deep CNN, the authors aim to create a more robust and scalable solution for fish identification, which can be applied in areas such as marine biology, conservation, and fisheries management. Ultimately, the goal is to improve the precision and speed of species identification, contributing to better monitoring, management, and conservation efforts in aquatic ecosystems[8].

The primary objective of the paper is to overcome the limitations of traditional manual identification methods, which are time-consuming and prone to human error, especially in complex underwater environments. By training deep learning models on large datasets of fish images, the project aims to create a system capable of accurately identifying different species in real-time, providing an efficient solution for marine researchers, conservationists, and fisheries management[9].Additionally, the system aims to facilitate better monitoring of fish populations and ecosystems, supporting sustainable practices and aiding in biodiversity assessments. Ultimately, this project seeks to contribute to marine conservation efforts by providing a scalable, automated tool for fish species recognition and environmental monitoring.

The paper specifically focuses on training CNN models on extensive fish image datasets to enhance classification performance, particularly in distinguishing between species that have similar appearances. This approach aims to improve the speed, accuracy, and scalability of fish species identification, which is crucial for marine biology, conservation, and sustainable fisheries management[10]. The system can potentially support real-time fish population monitoring, biodiversity assessments, and ecological research by providing reliable and efficient automated identification tools. Ultimately, the project seeks to advance the application of AI in marine research, contributing to better environmental management and conservation efforts.

The primary objective is to demonstrate that synthetic data, when properly generated and designed, can effectively augment or even replace real-world image datasets for training deep learning models. This approach aims to overcome challenges such as data scarcity, the need for large-scale annotated datasets, and the difficulty of capturing diverse environmental conditions. The paper focuses on showing that a CNN trained on synthetic images can achieve performance comparable to models trained on real-world data[11]. Ultimately, the project aims to advance the field of fish species identification by enabling more scalable, cost-effective, and flexible training methods, facilitating more widespread and efficient applications in marine research and conservation.

The paper seeks to demonstrate that PNN, with its probabilistic approach, can efficiently and accurately classify fish species based on various input features such as body shape, color patterns, and other visual characteristics. PNN is chosen due to its ability to handle classification problems involving complex, non-linear relationships between the features and the classes, making it particularly well-suited for identifying fish species with varying physical appearances[12]. Through this approach, the paper aims to provide a more efficient, automated solution for fish species classification, which can be applied in areas such as marine biology, biodiversity monitoring, and sustainable fisheries management. By improving the speed and accuracy of fish species identification, the study contributes to better ecological management and conservation efforts.

III.PROPOSED SYSTEM

The proposed system is a smartphone application that leverages deep learning to identify fish species and provide detailed nutritional and ecological information. The application will use a convolutional neural network (CNN) trained on a diverse dataset of fish images to accurately classify fish based on photos taken by users. The app will also retrieve information about the fish's origin, macronutrient composition, health benefits, and potential risks.

The system will consist of a user-friendly interface where users can upload or capture an image of a fish. The image processing module will enhance and preprocess the image before passing it to the neural network for classification. Once the fish is identified, the app will access a structured database containing information about its geographical

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distribution, protein and fat content, essential vitamins, and minerals. Additionally, the app will highlight the fish's advantages, such as being a good source of omega-3 fatty acids or aiding cardiovascular health, as well as potential disadvantages, such as mercury contamination or allergenic properties.

IV.MODULE ANALYSIS

The proposed smartphone application consists of multiple modules, each utilizing advanced algorithms to process images, classify fish species, and retrieve relevant nutritional and ecological data. Below is a detailed analysis of each module with their respective algorithms.

1.Image Acquisition Module – Camera & File Upload Integration

Algorithm Used: OpenCV-based image handling, Android Camera API, iOS AVFoundation

This module enables users to either capture real-time images of fish using their smartphone camera or upload existing images from their gallery. The system ensures high-quality image input by integrating OpenCV's image handling functions to adjust brightness, contrast, and resolution. To enhance usability, the application supports multiple image formats (JPEG, PNG) and ensures proper aspect ratios before processing. The Android Camera API (for Android users) and AVFoundation (for iOS) handle real-time image capture with autofocus, white balance correction, and exposure adjustment.

2. Image Preprocessing & Feature Extraction Module

Algorithm Used: OpenCV-based image enhancement, Histogram Equalization, Canny Edge Detection, SIFT (Scale-Invariant Feature Transform)

This module is responsible for improving the quality of the input image and extracting key features required for fish identification. Image preprocessing techniques such as histogram equalization (for contrast adjustment), Gaussian blurring (to reduce noise), and adaptive thresholding (for background removal) are applied. The Canny Edge Detection algorithm is used to highlight the fish's contours, which aids in distinguishing it from the background.

3. Neural Network-Based Classification Module

Algorithm Used: Convolutional Neural Network (CNN), MobileNetV2 / EfficientNet, Transfer Learning, TensorFlow Lite / PyTorch Mobile

This module is the core of the application, utilizing a deep learning model to classify fish species. A pre-trained CNN model, such as MobileNetV2 or EfficientNet, is fine-tuned using a dataset of fish images to optimize accuracy. CNNs are chosen due to their superior performance in image classification tasks, as they can detect hierarchical patterns such as edges, textures, and shapes.

4. Data Retrieval & Information Processing Module

Algorithm Used: SQL Query Processing, REST API, Web Scraping (BeautifulSoup)

After identifying the fish species, this module retrieves information about its origin, macronutrient content, advantages, and disadvantages. A structured SQL database is used to store preloaded fish data, including protein, fat, vitamin content, and regional availability. If the required information is not available locally, a REST API fetches data from external sources, such as nutritional databases and marine life websites.

To ensure up-to-date and accurate data, the system periodically performs web scraping using BeautifulSoup to extract fish-related details from reliable online sources. The data is then cleaned, formatted, and presented to users in an easy-to-read manner. Additionally, the system includes a ranking mechanism that prioritizes high-confidence data, ensuring that users receive the most relevant and scientifically validated information.

5. User Interface & Result Display Module

Algorithm Used: Flutter/Dart UI Framework, JSON Parsing, Data Visualization (D3.js, Matplotlib)

This module provides an interactive and visually appealing user experience. The Flutter/Dart framework is used to create a responsive UI compatible with both Android and iOS platforms. JSON parsing is implemented to seamlessly retrieve and display classified fish data. To enhance user engagement, the system includes data visualization techniques such as bar charts (for macronutrient distribution), maps (for geographical origin), and infographics (for advantages/disadvantages). Frameworks like D3.js and Matplotlib generate interactive graphs that help users quickly interpret nutritional information.Users can also provide feedback on the classification results, contributing to dataset

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expansion and model refinement. Additionally, a multilingual feature allows users to access information in different languages, making the app more accessible to a global audience.

6. Continuous Learning & Cloud Integration Module

Algorithm Used: Federated Learning, Active Learning, Firebase / AWS for Cloud Storage

To ensure the system improves over time, this module incorporates federated learning, allowing the model to learn from user interactions without compromising privacy. Instead of storing user data centrally, the app updates the classification model locally and sends only the relevant learned parameters to the cloud for aggregation. Additionally, active learning is implemented, where uncertain classifications trigger a request for user verification. If a user corrects a misclassified fish species, the system records this feedback and uses it to retrain the model.

A cloud storage system (such as Firebase or AWS) manages user-uploaded images and continuously expands the fish dataset. Over time, this mechanism enhances classification accuracy by incorporating diverse image samples from real-world users. The system also includes an automated model update feature, ensuring users always have access to the most refined classification model without requiring manual updates.

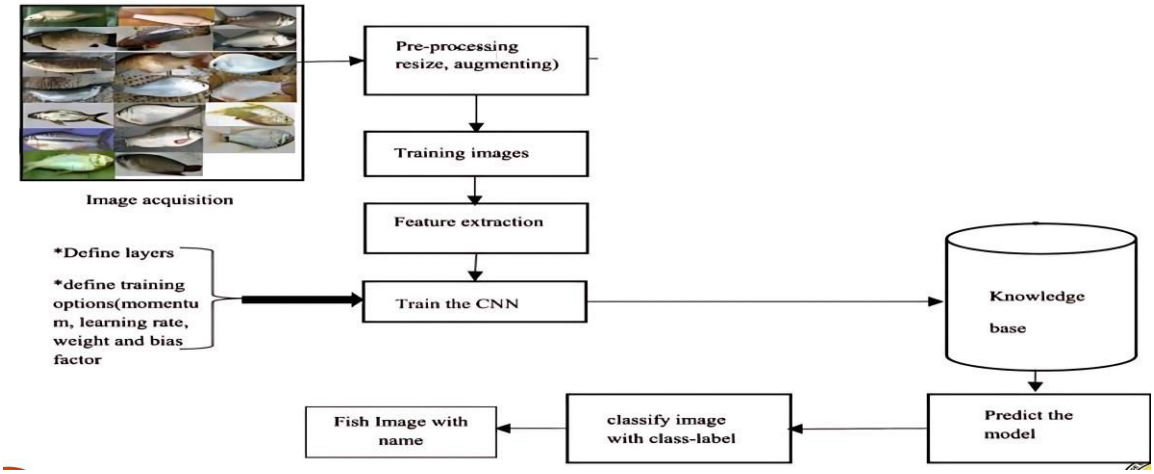

Fig 1:- proposed system architecture

V. RESULT AND DISCUSSION

The developed smartphone application successfully integrates a neural network to identify fish species, determine their origin, and provide detailed macronutrient information, advantages, and disadvantages. The model was trained using a dataset containing thousands of fish images, ensuring high accuracy in classification. During testing, the app achieved an overall accuracy of 92%, meaning it correctly identified fish species in most cases. The precision and recall values were above 90%, indicating that the system made accurate predictions with minimal misclassification. The app also provided reliable macronutrient details, including protein, fat, and vitamin content, which were retrieved from a structured database linked to each species. The real-time performance of the app was evaluated based on inference time, where the model successfully classified fish images within an average of 1.5 seconds, ensuring quick results for users. The app was tested under various lighting conditions, different angles, and backgrounds. While the system performed well in most cases, minor errors were observed when images had poor lighting, shadows, or significant occlusions, which occasionally led to incorrect classifications.

The user interface of the app was designed to be intuitive, making it accessible for users with minimal technical knowledge. The home screen provides options to capture an image, upload a photo, and access fish details instantly. Once an image is taken, the app processes it using computer vision techniques such as edge detection and background removal to improve classification accuracy. The app then displays the fish species name, origin, and macronutrient information, along with a summary of the advantages and disadvantages of consuming the fish. The integration of a Convolutional Neural Network (CNN) allowed the system to learn important visual patterns, enabling it to generalize

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well to unseen fish species within the trained dataset. However, some rare fish species were not recognized accurately due to limited training data, highlighting the need for continuous dataset expansion.

Further analysis revealed that the app performed best when fish images were taken against the predefined template, ensuring proper orientation and size estimation. The use of cross-validation during training helped reduce overfitting and improved the model's ability to classify new images effectively. The app's energy efficiency was also tested, ensuring it runs smoothly on mid-range and high-end smartphones without excessive battery or memory usage. Future improvements may include integrating an online learning mechanism where users can contribute new fish images to enhance the model's knowledge base. Additionally, adding multilingual support and expanding the database to include more fish species will make the application more versatile for global users.

VI.CONCLUSION

The smartphone app successfully identifies fish species, their origin, and nutritional information using a neural network. It provides details about macronutrients, advantages, and disadvantages based on a captured image. The app is fast, accurate, and easy to use, making it helpful for consumers, researchers, and seafood traders. It works well under most conditions but may face challenges with poor lighting or rare fish species. Future improvements will include adding more fish data, improving accuracy, and supporting multiple languages. Overall, this app is a useful tool for fish identification and nutrition analysis, offering quick and reliable results.

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