

# MATSYASTRA - An Automated Fish Species Identification using Teachable Machine Services

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**Abstract:** Generally, only feature values obtained from photos are used to identify fish species. But, it is challenging to identify fish species based on an image alone because fish of the same species can have varying hues or seem quite similar to other species. Additionally, it can be a tedious task that might lead to wrong predictions. Since various fish species exist, it is difficult to determine a fish without a proper model. Fast-growing computing and sensing technologies have improved most embedded systems, which help us solve more complicated algorithms. The main challenge is to perceive and analyze corresponding information for better judgment. An advanced system with better computing power can facilitate identifying fish species. Using the Teachable machine, a web-based tool for creating machine learning models, we can ensure that this application gives accurate results in classifying various fish species. An application that uses machine learning to identify fish categories is developed in this study by capturing images of fish and identifying their categories. In addition to providing fish information, this app also connects users with other fishermen, gives feedback on the fish, display catch logs, supports multilingual display of data, fish focused advisory chatbot, and market value information. User dashboards allow users to sign up, create profiles, scan, and identify their catches. This mobile application ensures the data integrity and confidentiality of the user's data. The overall performance of the application is responsive and user friendly.

**Keywords:** Fish Species, Identification, Teachable Machine, MATSYASTRA.

## I. INTRODUCTION

India has been one of the third largest countries in producing fish and the second largest aquaculture fish producer in the world. India contributes around 7% of global fish production due to the vast coastal region. It is also considered to be a homeland for more than 10% of the global fish biodiversity and is one of the 17-mega biodiversity-rich countries. These specifications of the country help around 14 million people who are engaged in fisheries and its allied activities [1]. The overall fish production during the period of 2017-2018 was 12.60 million metric tons, of which about 70% is from the domestic sector and nearly 50% of the total production is from culture fisheries. The nation's largest fish producer in Andhra Pradesh, followed by Gujarat and West Bengal. In total, 75 countries around the world are exporting fish products and 50 different types of fish. India exported 13.77 lakh tons of fish and fish products, worth Rs. 45,106.89 crores, making it the largest group of agricultural exports [1]. In addition to contributing 0.91% of the nation's GDP (Gross Domestic Product) and 5.23% of its agricultural GVA (Gross Value Added), this makes up nearly 10% of the country's total exports and nearly 20% of its agricultural exports. (Fish and Fisheries of India, n.d.)

**Fish Diversity of India\***

Native Fishes	Number of Species
Marine Ecosystem	1518
Brackishwater Ecosystem	113
Freshwater Ecosystem	877
<b>Sub-total</b>	<b>2508</b>
<b>Exotic Fishes</b>	<b>291</b>
<b>Total</b>	<b>2799</b>

**Table-I:** \*Uttam K Sarkar, JK Jena, Shri Prakash Singh, AK Singh and SC Rebello (2012). Documenting Coastal Fish Biodiversity of India: Status, Issues and Challenges. "International Day for Biological Diversity, Marine Biodiversity", 22 May 2012, Uttar Pradesh State Biodiversity Board, Lucknow, pp. 22-28. [1] (Fish and Fisheries of India, n.d.)

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## A. Marine Fishery

The process of learning about the resources under the ocean has been sped up by fisheries research and technical development. Future fisheries development plans for India are intended to boost fish productivity while also enhancing community welfare, fostering exports, and ensuring food security. Indian maritime fisheries have a wide variety of the typical tropical species. Our oceans are home to some 2,500 different species of fish and shellfish. From roughly 0.6 million t in 1950 to 2.67 million t in 1998, our catch fisheries grew steadily, with an average annual growth rate of 6.4% over that time. Satellites like OCEANSAT in 1999, helped us in identifying the aggregation of fishes through real-time satellite pictures of oceans.

## B. Marine Fishery Advisories [2]

Due to the geographical implications of India, and its impact on country GDP, India has constituted several Institutions and supporting agencies like Ministry of Earth Sciences, Department of Space and several organizations under the umbrella of Ministry of Agriculture both in cent which helps the people and dependents of this zone by providing the Potential Fishing Zone Adversaries to the Indian Fishing Community. INCOIS (Indian National Centre for Ocean Information Services) is one of the organizations help for this purpose since many years.

## II. LITERATURE SURVEY

### A. Fish Species detection using Deep Learning Model [3]

In this source the author Suxia Cui et al presented a design and use of Autonomous Underwater Vehicle which is embedded with computing and sensing technologies. This device uses algorithms like CNN used for fish detection and can work in various ocean water conditions effectively.

### B. Fish identification using image processing techniques [4]

Here authors Siti Nurulain Mohd Rum and Fariz Az Zuhri Nawawi has presented a prototype system named "FishDeTec" that can detect the freshwater fish species in the region of Malaysia. This model uses VGG16 for a large-scale image classification process and produces good results.

### C. Visual features based automated identification of fish species using deep convolutional neural networks [5]

In this reference, Hu et al. propose a novel fish species identification model based on texture features, color, and a multiclass support vector machine. The color and structural features of the fish skin were captured from the original image. LIBSVM software was used to select the best feature for accurate identification. The accuracy achieved is over 90% in classification using the LifeCLEF14 and LifeCLEF15 benchmark fish datasets.

### D. FishVerify: ID & Regulations [6]

"Fish Verify" is one of the mobile apps especially for Android users. This app helps users to identify hundreds of Freshwater and Saltwater fish with a single click of a camera. The app provides local fish regulations on size and

bag limits based on user GPS location. This app also provides current weather and water conditions including air temperature, barometric pressure, cloud coverage, sunrise time, sunset time, wind, moon phase, tides, water temperature and wave heights. It also includes space to log your catches and ask an expert to identify your catch.

### E. Seabook – Fish identification [7]

"Seabook" is an app to identify underwater fish, creatures or corals based on the given information and features. This app considers 78 identification groups of fish and the total number of groups and subgroups is 275 species. It is considered as the perfect app for aquarium enthusiasts, scuba divers, free divers, snorkelers, and who would like to discover marine life. The users can search the species by color, pattern, location, body shape, social behavior, tail fin shape, etc. As a result, the following features like species photo, a short description of the species, its distribution, habitat, its life style, maximum size and depth of the species and other aspects are displayed.

### F. Fish Identification – Fish Scan [8]

This app is used to identify the fish by its photo or video automatically. After taking the photo or video, a classification will appear with the five scientific names of the fish that are most similar, and by pressing the corresponding button you are directed to the information about the fish on the internet. It is divided into river, sea, and aquarium fish to make their identification easier.

### G. Identifish [9]

This is also a mobile application that helps the users to identify the fish species information. This app is embedded with over 200 fish species. The application is prepared to work with low minimum resolution that could cater the needs of all weather conditions. From the literature survey, it can be found that fish identification is done using deep learning algorithms with higher accuracy than a human. Many mobile applications are also developed which identify the fish and also provide other features like fish regulations, display catch logs, ask queries to an expert, etc.

## III. ABOUT DATASET

It is possible to classify fish into two categories, saltwater fish and freshwater fish. Freshwater and saltwater fish differ in their physiology, structural adaptations, and size when compared. From Kaggle, we collected data on freshwater and saltwater species, widely available on the Indian subcontinent, which contains 4000 images from 468 species of fish. Based on INCOIS's suggestions and guidance, datasets are reduced and prepared. The four finalized parameters through which we can identify the fish are

- The shape of their heads,
- The location of their mouths,
- Fin type and location,
- Average adult size.

The most common fishes found around the coastal regions and rivers are Pomphret, Bombay Duck, Mangrove Red Snapper, Milk Fish, Indian Oil Sardine, Indian Mackerel, Ghol, etc.



Our application also provides information about the fish species, such as

- Marine weather forecasts.
- Minimum and maximum size of the fish.
- Seasonal availability of the fish.
- Edibility.
- The local market average price of the fish.
- Medicinal values of the fish, and
- Edibility.

#### IV. DESIGN AND METHODOLOGY

##### A. Design

The application outlook is designed using comprehensive HTML, interactive and motion CSS pages. Some templates and UI components enabled eye-catching animations are built using Canva, Framer and Figma. We initially wireframed the overall application outlook for a better understanding of the workflow of the application. Through this method we mitigated inconsistencies in navigation and few counterintuitive flows are fixed. We designed our application in such a way that it effectively communicates the main idea of the app to a variety of users interacting with the application. The visual framework of our app creates a coherent and consistent experience to the users. Some of the UI elements are designed in Sketch and Photoshop applications. The design of the application covers all functionalities and features of the application which includes a login, register page, profile slider, scan and upload page, chat bot, blog page. Further, our application is user-friendly, and platform independent. Functionalities of the application are as follows:

- scanning and uploading fish species images - for fish identification using machine learning model
  - information and details of the fish
- Some of the salient features of the application are as follows: supports multi-lingual

- news and updates
- recent history
- weather forecast
- fish focused advisory through a chat bot
- feedback to INCOIS
- dark mode and light mode
- invoice notifications

Some of the pros of the application are as follows:

- responsive
- cloud-based service
- less storage and user friendly

##### B. Block Diagram and Methodology

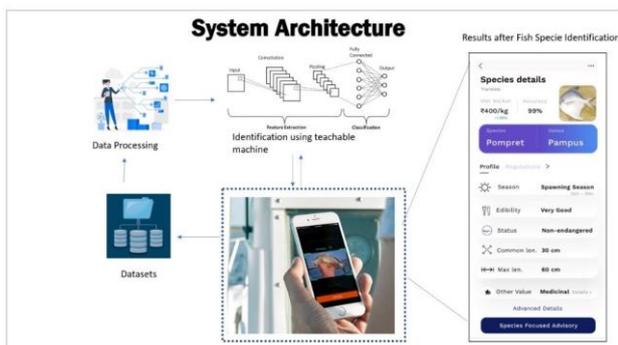


Fig 4.2.1 System Architecture

- The procured Data Set elucidated in the section 3 is fed into the pre-trained machine learning model of Teachable Machine [10].
- We used a web-based tool called Teachable Machine services. Teachable Machine allows you to quickly and interactively train a computer vision system. It is a web-based tool that makes creating machine learning models fast, easy and accessible to everyone on the planet. Instead of programming, we can create a training model, to enable your computer to learn. We have built our model with the collected dataset, trained it with good accuracy and finely exported it into our application by using Teachable Machine.
- Teachable Machine trains and runs the models you create in your web browser using TensorFlow.js, a JavaScript machine learning library. These models employ a method known as transfer learning. The classes are assumed as the final layer or phase of the pre-trained neural network that pre-exists.

#### V. RESULTS AND DISCUSSIONS

The output of this model is a Web application that has the features mentioned in section 5.1. The below table depicts the flow and usage of the application.



Fig 5.1: Welcome Page

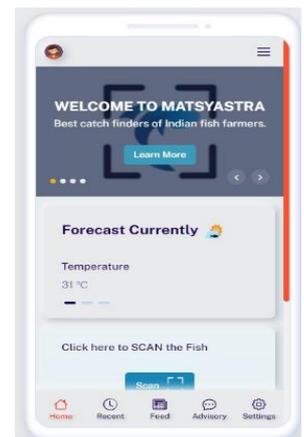


Fig 5.2 Home Page

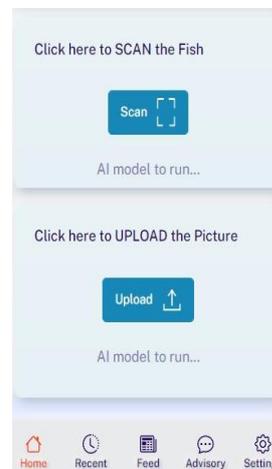


Fig 5.3 Scan & Upload

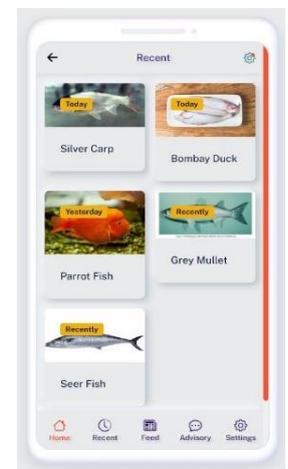


Fig 5.4 Recent Catches



Fig 5.5 Updates Page



Fig 5.6 Messenger Page

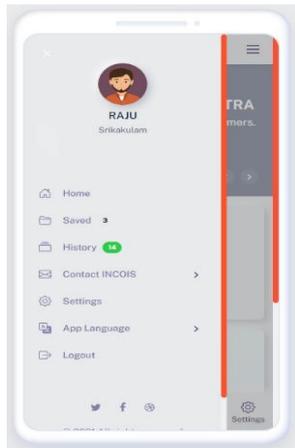


Fig 5.7 Profile Page

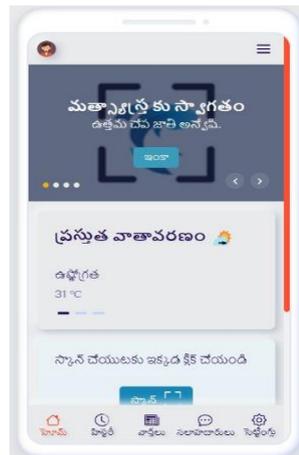


Fig 5.8 Regional Language

Attributes	Values
Species	Indian Anchovy
Average Price	Rs500 per kg
Season	September to January
Edibility	It is edible
Status	Exists
common length	22cm
Max Length	45cm
Medicinal Values	It is a great source of calcium, vitamins A and D, and B vitamins, including Vitamin B12, vital for the nervous system

Fig 5.9 Catch Log

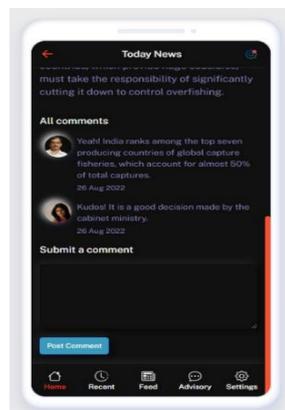


Fig 5.10 Feedback Page

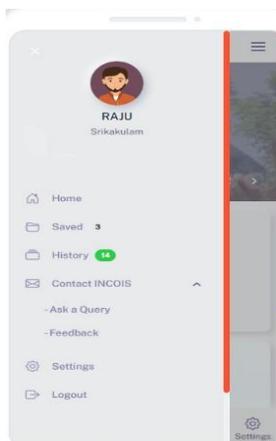


Fig 5.11 Contact INCOIS

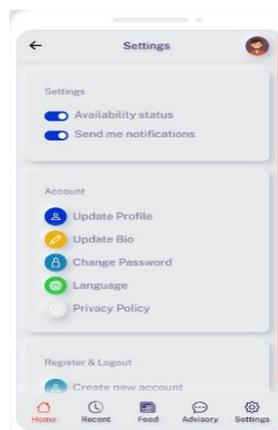


Fig 5.12 User Settings

A. Discussions

- The Web Application contains different pages like Welcome Page, home page, scan & upload page, Page Showing Recent Catches, Updates Page, Messenger Page, Profile Page, Home Page in Regional Language, Additional Info of Catch, Feedback Page
- Fig 5.2 Home Page** allows the user to check the current forecast and to navigate to other pages. It is a window to access the different features and functionalities of the app. User can understand the navigable sections of the app at one glance here.
- Fig 5.3 Scan & Upload Page** allows the user to scan or upload their catch in one click. When the user clicks Scan button, the application requests the webcam access, whereas when the user clicks Upload button, the application requests to access the files of the computer in .jpeg or .png form.
- Fig 5.4 Recent Catch Page** displays the saved record of catches that the user has recently scanned/uploaded.
- Fig 5.5 Updates Page** updates the fishermen with the real-time news pertaining to the Fisheries and Ocean climate etc.
- Fig 5.6 Messenger page** is a chat bot of Fish Focused Advisory team to perform one-to-one discussions with the active users regarding their catch, supply, regulations etc.
- Fig 5.7 Profile Page** contains the information of the user and other navigation options such as History, Contact INCOIS, and Settings.
- Fig 5.8 Regional Language Page** is to make the application available to the fishermen in local languages. Users who are less familiar to English, can use our web app in their respective regional language with ease.
- Fig 5.9 Catch Information Page** provides the additional information of the catch. This information includes medicinal values, cost, length, availability season, and edibility.
- Fig 5.10 Feedback Page** allows the INCOIS team to collect feedback from the users.
- Fig 5.11 Contact INCOIS** is an additional option on the profile bar where the user can ask a query or provide feedback directing to Feedback Page (Fig 5.10)
- Fig 5.12 User Settings Page** allows the user to alter several settings of the application such as notifications, resetting the display language, and updating account settings.

VI. CONCLUSIONS

Fish capture data at the species level must be gathered in order to assess its correctness and create advice unique to each species. Even while fishermen support these initiatives, species level catch reporting frequently faces challenges because of manual efforts that lead to poor or inaccurate reporting for a variety of reasons.



So, this project made a contribution in identifying the fish species through an application in which a fisherman can just scan or upload the fish image and get the related information regarding fisheries. And the related information includes the physical measurements of the fish, medicinal values, edibility, price etc. There are another few additional features that are developed in order to enhance the user experience of the fisherman.

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