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Smart Fish Consumption Mobile Application

Rashmi Sandeepani, Erandi Weerasooriya, Sachin Dissanayeke, Kasun Senarathna
Information TechnologySri Lanka Institute of Information TechnologyMalabe, Sri Lanka

Abstract:-The marine food industry in Sri Lanka has experiencedtremendouscommercialsuccess.Beinganislandnation, Sri Lanka's economy has an impact on both its domestic and export sectors. Both the social and economic sectors are impacted by a successful fish catch. Seafood may considerably contribute to our nutritional needs because it is a source of high-quality protein, vitamins, and minerals while being low in saturated fat. For a very long time, practically every nation on earth has included fish in considerable quantities in its citizens' diets. Smart fish consumption improves people's chances of living long, healthy lives. The ability to recognize, detect, and determine the value of what individuals use is made possible by the technological implementation of this unique idea. The Four key functionalities food fish price prediction, food fish species identification, whole fishqualityidentification,andfishfilletqualityidentification were presented in order to achieve the specific solution. The suggested approach was implemented using Multiple Linear Regression and Convolutional Neutral Network (CNN) algorithms which are EfficientNetB7, InceptionV3,Resnet50.

Keywords:- *Multiple Linear Regression, Convolutional Neu tral Network, quality identification, price prediction.*

I. INTRODUCTION

Fish has a high nutritional value and is suited for household consumption, hence demand for food fish has been growing globally. Because they have the highest concentrations of omega-3 fatty acids, which are essential for brain growth and development. People who frequently consume fish had a decreased risk of heart attacks, strokes, and mortality from heart disease, according to several major epidemiological studies. [1] Even though consumers preferred to buy and eat fish that had just been caught, local markets frequently display and sell fish that has been in the water for longer than two weeks when it is brought in from the oceans. In order to secure their safety, fish consumers must practically check for quality indications to determine whether the fish they are about to eat is fresh or not. Traditionally, fish's eyes, gills, and other body parts have been sensory assessed to determine how fresh it is. Even while these qualities are obvious to the unassisted eye, a typical client cannot assess thefreshnessofthefishwiththesameaccuracyassomehighly qualified professionals. [2] Along with the whole fish Quality identification quality of the fish fillets will also be determined with this proposed solution. As time goes by, fish becomes more and more desirable. Therefore, forecasting fish prices is crucial for improved fisheries selling objectives as well as consumer and merchant consuming decisions. These business ownersandcustomers,however,typicallydon'thaveadetailed understanding of how food fish costs change. For the fish species identification fish can be characterized by the form their heads are shaped, where their mouths are positioned, the type and location of their fins, and their averageadult size. When used in association with other elements, such as geographicrange,colormarkings,suchasverticalstripesorfin spots, may also aid in the differentiation of fish. Thisresearch's main objective was to provide a solution for enabling thequick identification of fish species, the prediction of future food fish prices, and the classification of the freshness in terms of whole fish and fishfillets. [3]

II. LITERATUREREVIEW

Thecomputervisionandsegmentationtechniqueshavebeen utilized in the past to identify food flaws including blood spots and the appearance of uniform color in fish fillets. [5]. In that study, a method for automated pixel-by-pixelsegmentation was presented, allowing RGB images to be used forsegmented images. For the purpose of classifying defective fillets,support vector machines had been developed. To provide greater accu- racy, pixel-wise and SVM-based models had been developed. Using an image analysis technique, the degree of harm and blood spots in red salmon (Oncorhynchus nerka) fillets had been measured. [6]. Images of 15 fillets with varied degrees of damage were taken with a DSLR camera or a video camera. Additionally, the identical fillets were captured using the same camera in both well enough light and dimly light conditions. In all cases, the polarized light was flashed at an angle to highlight the imperfections of the flesh. There has been developed a representation method of analysis that use a L in an adaptive manner. The threshold value for the image is determined by the average color of the image. Determine the proportion of the fillet area that has a L value that is less than or equal to L. The lighting changed the atmosphere. In order to predict future prices, it had been used a variety of approaches, including developing a theoretical framework for the factors that affect prices. In addition, the basic functions of backpropagation neural networks and genetic neural networks with comparisons were employed to predict prices. Another study takes into account the fish fillets' surface color and blood spots (dark dots). [9]. On the other hand, never think about fish fillet surface damage. Certain damages in fish fillets are the focus of other studies. [10]. However, the mobile application that the members will create contains many more features in addition to the fundamental studies. Using image processing techniques, this program enables users to assess the quality and freshness of fish fillets. A fish fillet's quality can be determined by looking for things like cloudy, discolored, dark spots, scratches on the surface, and a consistent color over the entire surface. According to the available research papers [6] a method based on image processing was developed by the researchers to assess the freshness of fish samples.

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Itinvolvesfeatureextractionfromasegmentedredchannel picture of the gills and feature analysis of the coefficients of the wavelet transform. According to another research paper [7] the segmentation of the region of interest from the fish picture, which is the pupil of the eye, and analysis of the features retrieved from the segmented region of interest are the two components of the suggested technique. One of the existing studies uses image processing techniques todetermine the quality of the entire fish. In order to do so, it had used the fish's eyes or gills to determine its quality and freshness. The image sets of the gills or eyeballs that were captured had been processed. [8]. The range of fish freshness had been discovered by segmenting the altered image based on color. That described research study had cared about one parameter, which was either the fish eyes or the skin. That had limitations aswell.

III. METHODOLOGY

This study's main goal is to determine how to make it convenientforuserstoconsumefishformealsinaproperway. There are four primary goals that are consisting in research study which are named as Food Fish Price Prediction, Food Fish Species Identification, Whole Fish Quality Identification and Fish Fillets QualityIdentification.

A. *Food Fish PricePrediction*

The suggested system's fish price prediction module, which predicts fish prices uses the multiple linear regression machine leaning model. Multiple regression is a form of regression in which there is a linear connection between two or more independent variables and the dependent variable. It may also not follow a straight line; in which case the dependent and independent variables are said to be non-linear. Both linear and non-linear regression use two or more variables to visually monitor a specific response. Since non-linear regression is based on assumptions learned by trial and error, it is typically challenging to implement. This component's research was carried out using a methodical process. The Fisheries and Aquatic Resources department provided the data set with historical fish prices. 2700 of food fish prices of the chosen fish types at wholesale and retail for the chosen time period wereincludedinthedataset.

	Fish Type	Number of days kept until selling date	Price per kg(USD)	Province	day	month	year
0	Kelavalla	14	7.11	Western	18	9	2022
1	Thalapath	17	7.21	Western	18	9	2022
2	Balaya	5	4.38	Western	18	9	2022
3	Linna	10	2.19	Western	18	9	2022
4	Salaya	2	1.91	Western	18	9	2022
...	...	...	...	...	...	...	...
2695	Linna	7	2.90	North Western	1	8	2021
2696	Kelavalla	12	6.80	North Western	1	8	2021
2697	Balaya	9	4.51	North Western	1	8	2021
2698	Thalapath	3	8.17	North Western	1	8	2021
2699	Salaya	6	2.01	North Western	1	8	2021

2700 rows × 7 columns

Fig.1: Fish Prices Data Set

For data insights to eventually be converted into value for the end user, the data purification technique was used. To create and offer a better solution, it was essential tounderstand what was actually happening. This data cleaning process aids in finding two issues in the original fish pricing data set. They are the missing values and outliers. To prepare the data for modeling, it was necessary to clean the data. Following data cleaning, data exploration is carried out. The raw fish pricing data set was processed in order to find patterns and linkages. Prior to developing the model, data cleaning anddata exploration were the crucial steps. It was identified that there were 5 variables which affect for the fluctuation of fish prices. They were fish type, date of the fish captured, Number ofdayskeptuntilsellingthefish,Areathatfishwasselling.

B. *Food Fish SpeciesIdentification*

Today,alargepercentageofpeopleeatfishwithoutknowing what kind of fish they are consuming. They are ignorant of fish's nutritional value. Fish come in a variety of shapes and have unique traits, which explains this. To identify a fish, you canmainlyutilizeitscolor,fins,andscales.Thesecomponents differfromfishtofish.[11]Thesecomponentsutilizemachine learning and image processing to automatically recognize fish. Many different species of fish are photographed using the camera, and image processing is typically performed to improve graphical information. Those species are Yellowfin tuna(Thunnusalbacares),Skipjacktuna(Katsuwonuspelamis) and Giant trevally (Caranxignobilis). [12] In this case, the photographs were manually taken. It was included around 5000 photos including above mentioned fish species. Test and training photo categories were created using the data collec- tion.

C. *Whole Fish QualityIdentification*

Whole Food Fish Quality Identification is one of the primary functionality of our "Smart Fish Consumption Mobile Application" research, and it plays a significant part under a few different sub functions.

- Identifythewholefishqualityusingeyesofthefish.
- Identifythewholefishqualityusingeyesofthegills.
- Displaythefreshnesslevelsastheresult.

Regardless of the type, consumers believe that the freshest fish is the tastiest fish since it is better for consumption and health. Consumers of fish must be safe, so it is important to examine quality indicators to determine if the fish they are about to eat is fresh or not. A sensory examination of the fish's eyes and gills is how freshness in fish is traditionally determined. Even though these qualities are observable to the naked eye, an ordinary client, cannot accurately evaluate the freshness of the fish. Therefore, this method makes it simple and time- efficient for consumers to determine quality using current equipment quickly and

automatically. That is the functionality's primary significance for the suggested approach. [13] The first and most important stage that must be properly completed is gathering the data set for the functionality. The factors used in this research to evaluate the fish's quality were the color of the food fish's eyes, gills, and skin. Three different varieties of fish, Skip Jack tuna, Frigate tuna, and Yellow Fin tuna, were randomly chosen from the fish selling center, and the data set was then divided into fresh and non-fresh categories by a renowned specialist in the field of fish. The sample data set has been obtained, as shown in fig. 2 below. This data set was created in two different environments and used time period is two weeks.

- Normal Environment
- Frozen Environment.

Feature extraction, feature comparison, edge detection, RGB detection, picture improvement, and data augmentation are among the techniques utilized in the image processing strategy. This approach made use of the CNN Algorithm. The acquired data set was separated into train and test categories. The InceptionV3 model was trained on the data set, and the highest accuracy obtained was 96.5%.

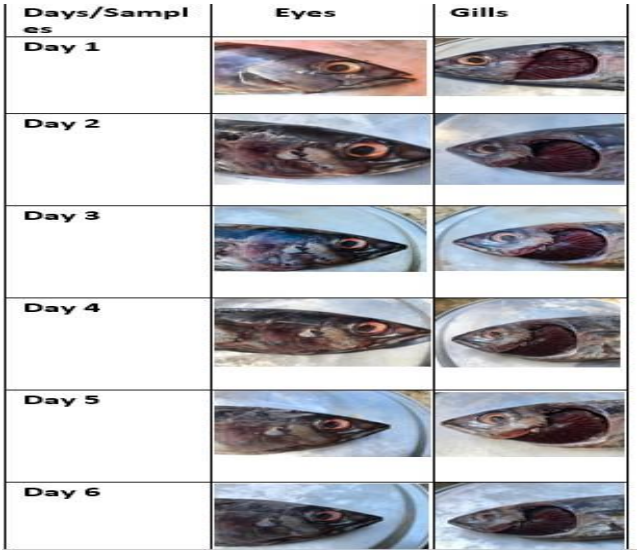

Fig. 2: Collected data set of whole fish

D. Fish Fillets Quality Identification

The overall research product would be a cross-platform mo-bile application to track variables made up of the system's four primary features. Among them," Fillet quality identification" is widely mentioned. Digital image processing typically usesimage processing to boost graphical information Through the camera, pictures of the fish fillet are captured. Both healthy and unhealthy cap samples were used to generate pixel graphics. To minimize unnecessary noise, smooth the images in the pre- processing software. Using image filtering techniques, unde- sirable parts can be removed while changing, emphasizing, and improving the image. The contrast is raised using image enhancement. To modify contrast, images are subjected to intensity transformations. To obtain the necessary area of the image, the diseased image may be shrunk, cut, and/or cropped. Making an image's representation simpler to comprehend and analyze is the fundamental purpose of image segmentation. The process of dividing a picture into many parts with the sameorsimilarfeaturesisreferredtoassegmentation.The picture is divided into components, so unnecessary elements are removed, and necessary segments are added for finish.[14] Kindicatesthatthedatahadbeensegmentedusingaclustering approach. The practice of placing photos into one of many specified groups is known as image classification. The most crucialstepsinclassificationaretrainingandtesting.

IV. RESULTS ANDDISCUSSION

A. Fish PricePrediction

Making price predictions is a crucial part of manyeconomic choices. There are many uses for forecasts, hence in this study with the tested machine learning models it was identified that the most accurate result providing model as multiple linear regression model. It was taken into account all the independent factors that have been recognized as prospective independent variables prior to model creation. They are fish type, date of the fish captured, Number of days kept until selling the fish, Area that fish was selling. As the final result of the model, it was gained 0.946 model score which depicts that the accuracy rate.

B. Food Fish SpeciesIdentification

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The CNN model was selected to serve as the trainingmodel. Other models, such as Inception v3 and Xception, were tried, but it was discovered that the EfficientNetB7 had a higher level of accuracy. The model's accuracy increased to more than 82 percent after training and all techniques for data augmentation were applied to the pre-trained model. [14] The actualfindings,predictedoutcomes,andconfidencepercentage for each fish species were then provided by the algorithm after it had randomly chosen and rearranged of the pieces. It was able to obtain an accurate result as the end result of the data set training as a representation for the outcome of fish species identification.

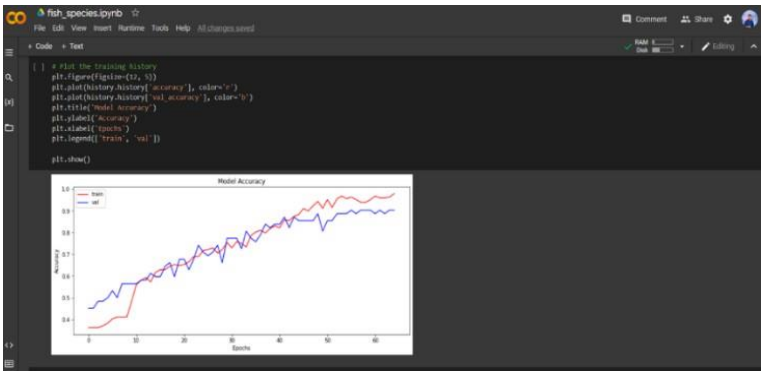

Fig. 3. Accuracy result of the model

C. Whole Fish QualityIdentification

The outcome of this research has provided the insight for food fish consumers about how to consume fresh and healthy food fish, how to know the future prices of fish using modern technology. Due to the current research's limitations, theoutcomeshouldbeconsideredcarefully.Areviewofthe research process is given in this chapter. InceptionV3 model was used to train the model and was able to get the highest accuracy which is 98.1 percent. Used 15 epochs to train the model. The result that was exhibited after training theacquired data set in accordance with the chosen model, InceptionV3, is shown in Figure 4 and that Figure illustrates the accuracy result attained by training the earlier discussed model. After training the data set, we were able to obtain an accurate result that categorizes fishfreshness.

Fig. 4: Validation and Accuracy Plot

After model training, the Result Displays as Below.

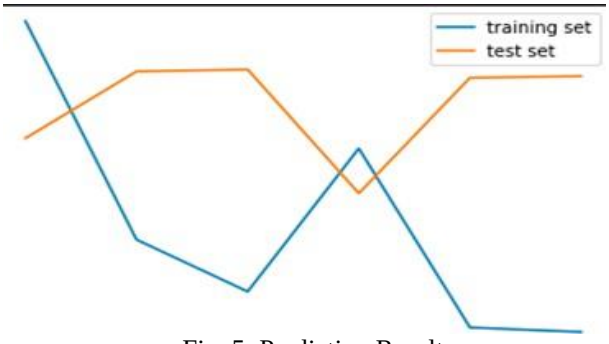

Fig. 5: Prediction Result

- Fresh
- Level 1 –ModeratelyNon-Fresh

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• Level 2 –Highly Non-Fresh

D. Fish Fillets QualityIdentification

Several types of models including Inception v3 and Xceptionweretriedtoimplementthefishfilletqualityidentificati on when it was trying with CNN models but it was found that the Resnet15V2 model had a greater accuracy rate. After training, the model it could achieved an accuracy of more than 90 percent, and all strategies for data augmentation were used on the pre-trained model. The output of the fish fillet model after randomization and item selection was the actual result, predicted result, and confidence percentage. The result wasdisplayedina3x3tablewiththefollowingimage.Thegraphin g Google Collab displayed the validation accuracy and loss in this instance.[16]

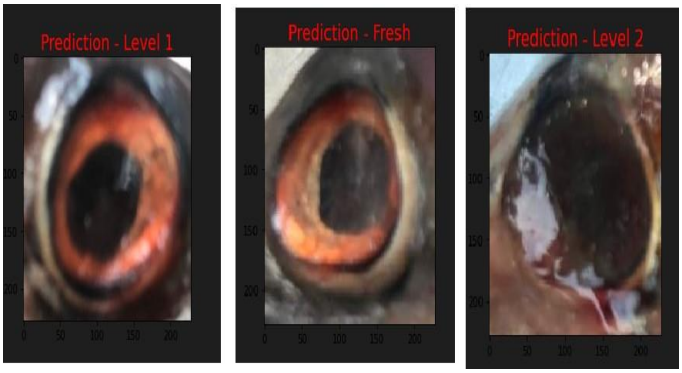

Fig. 6. Final output from the model

V. CONCLUSION

The main objective of this study was to provide solutions for evaluating the quality of whole food fish and fish fillets. Additionally, it was tried to calculate the price of the fish. Hope to consider a variety of factors in order to ascertain if the fish is of high quality or not. Regardless of the type, consumers believe that the freshest fish is the best fish since it is better for consumption and health. Consumers of fish must be protected from harm by using quality indicators to determine if the fish they are going to eat is fresh or not. A sensory examination of the fish's eyes and gills is how freshness in fish is traditionally determined. A typical customer, unlike certain highly qualified professionals, cannot precisely assess the freshness of the fish despite the fact that these features are visible to the unaided observer. The cost of fish is significantly greater than that of other animal-based food items, according to statistics from a number of sources relevant to fisheries, and wholesale market fish prices have been steadily rising over the preceding five years. Since it may offer data on price performance over time as well as projections for future levels that are advantageous to retailers, fisheries pricing modeling is significant in this context. By providing above discussed solutions, it is intended that the population of Sri Lanka will live in better health and that inaccurate concerns about buying fish will be allayed.

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