Annals of R.S.C.B., ISSN: 1583-6258, Vol. 25, Issue 7, 2021, Pages. 1341 - 1349
Received 05 May 2021; Accepted 01 June 2021.

An Improved Deep Convolutional Neural Network (DCNN) for finding the Fish Freshness

Maddala Janakidevi[1], TVKP Prasad[2], Pamula Udayaraju[3],

[1, 2, 3] Assistant Professor, Department of CSE, SRKR Engineering College (A),

mjd@srkrec.ac.in[1], tvkpp@srkrec.ac.in[2], pur@srkrec.ac.in[3].

Abstract: Finding the fish freshness is most significant task with existing models. It is very important to overcome the various issues such as accuracy in detecting the fish freshness. Deep Learning (DL) is most widely used to detect the process of finding the solutions to the complex tasks. This paper mainly focused on detects the fish freshness automatically by analyzing the fish images. In this paper, A Shallow deep Convolutional Neural Network (SD-CNN) is proposed in this work instead of device approaches. A pre-trained model which is VGG-16 architecture is used to extract the features of the fish images to find the freshness of the fish or not. In order to classify fish images, an improved classifier is used to create drop-out and dense layers. Then a novel deep learning algorithm is applied on the fish dataset. Different methods are used to find the fish freshness such as SVM, DCNN. By using these methods several drawbacks are identified such as lack of accuracy, precision and Recall. The proposed model is SD-CNN that improves the performance in terms of accuracy is 97.76%, Precision is 97.06 and recall is 0.96.

Keywords: Deep Learning (DL), Shallow deep Convolutional Neural Network (SDNN), VGG-16, SVM, DCNN.

Introduction

Fish is the one of the healthy sea food that can taken by the many food lovers. The eating habits will increase the consumption of the aquatic items and this includes fish, and also used to find the quality of fish. Freshness of the fish can be done by industries to measure the quality of the fish to supplies directly to the consumers. Several factors shows impact on detecting the fish freshness that includes selecting, processing and methods for storage from capture to retail; some of these factors may affect the fish freshness finding by using various chemical, physical and microbiological changes that can done by using various previous selected methods. Among all the fishes, crap fish is world's third largest developed fish species in aquaculture.

The popular techniques widely used to preserve fish quality are cooling, freezing, and drying. It is of great importance to establish novel methods to evaluate fish quality. It is very difficult to find the fish freshness that is having with large quantities. Many traditional and previously used techniques are developed to find the accurate fish freshness that defines the quality based on the size, color, shape of the fish. It is very important to develop a novel and better algorithm to detect and gives the accurate result of giving fish freshness. Fuzzy logic is used to aggregate and analyze data from the electrodes.

The dielectric characteristics of fish skin and muscles are measured using electrode sensors. To conduct a comparative study of the various methods for maintaining fish freshness and to determine

Annals of R.S.C.B., ISSN: 1583-6258, Vol. 25, Issue 7, 2021, Pages. 1341 - 1349
Received 05 May 2021; Accepted 01 June 2021.

the best approach. The freshness of fish can be determined by several factors, including time on ice, duration in frozen storage, storage temperature, processing time, equipment and chemicals, overall cost, acceptance, and so on. In this paper, the VGG-16 pre-trained model is used to develop the accurate feature extraction by using various layers in CNN such as convolution layers, pooling layers, and dense layers are integrated for efficient training on fish datasets which is explained in figure-1. The proposed algorithm is Shallow deep Convolutional Neural Network (SD-CNN) is implemented to overcome several issues. The performance is calculated by showing the accuracy, precision, recall, and F1-measure.

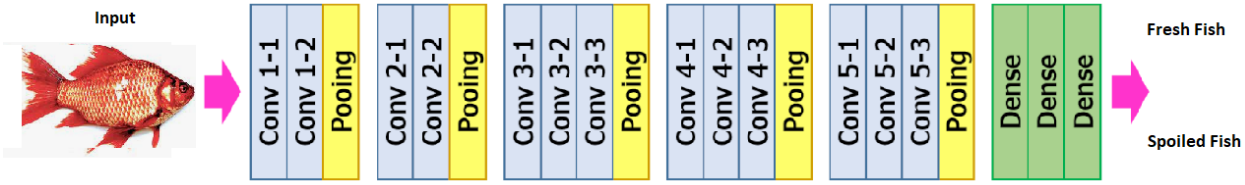

Figure 1: Training with VGG 16 Architecture by using various layers based on the freshness and spoiled fish

Literature Survey

Winiarti et al. [1] made a characterization framework to order four gatherings of consumable fish by gathering fish pictures dependent on surface extraction and shading qualities. By utilizing the HSV shading model (Hue, Saturation, and Value) and GLCM (Gray Level Co-event Matrix) techniques, the fish meat picture is determined. KNN was utilized as the calculation for grouping dependent on the investigation of fish picture tones. By utilizing KNN calculation the precision is extremely low.

Agueria D et al. [2] fostered another QIM conspire. It will be valuable for pragmatic assessments of carp newness in all means of the creation chain, and it will add to a more powerful utilization of the species as an option for human food supply.

Hosna Mohammadi et al. [3] utilized Digital picture preparation to test the newness of rainbow trout fish by following the shading qualities of the eyes and gills. In a 10-day ice-stockpiling period, picture information was gathered from the left and right eyes and gills, and shading parts were separated in shading spaces of RGB, HSV. Element extraction from the shading spaces was taken out and afterward fake neural organizations (ANNs) and backing vector machines (SVMs) were carried out for ice-stockpiling time order. For both the separated provisions from the eyes and gills, the general precision of the created models showed that the ANN is fairly better than SVM.

Navotas et al. [4] made an android application in their review which consequently recognizes the three most burned-through fish in the Philippines, to be specific milkfish and Well, tilapia. The application orders the newness of the fish from level 1 (old) to even out 5 (new) by picture handling by utilizing the RGB upsides of the eyes and gills and by assessing its excess timeframe of realistic usability. The innovation was worked through iterative learning of a neural feed-forward network.

As indicated by A. Mohamed et al. [5], The discoveries of numerous specialists showed that the pH and another newness of the fish were extraordinarily related, recommending that this Instead of

Annals of R.S.C.B., ISSN: 1583-6258, Vol. 25, Issue 7, 2021, Pages. 1341 - 1349
Received 05 May 2021; Accepted 01 June 2021.

tangible assessment strategies that are innate in numerous vulnerabilities, actual attributes could be utilized as a fitting apparatus for examination and fish newness investigation. Contingent upon this interest, the reason for this paper was to survey the writing that focused on the pH of the fish.

Kishore Dutta et al. [6] proposed a strategy for picture handling which is completely programmed, viable and non-damaging for tissue division and forecast of fish test newness. Utilizing a grouping-based interaction, the gill tissues of the fish test are naturally fragmented and their components are deliberately separated in the element extraction by utilizing the Haar channel space.

Abdelhameed Ibrahim et al. [7] introduced a division model in their examination utilizing the Salp Swarm Algorithm for fish photographs (SSA). The division is that of Formulated by the course of Simple Linear Iterative Clustering (SLIC) with the SSA-streamlined starting boundaries. It utilizes the SLIC approach to deliver minimized and practically uniform superpixels, bunch picture pixels. At long last, the thresholding utilized by the Otsu strategy assisted with showing great precision from the first pictures of separated fish under different pictures.

Taheri-Garavand et al. [8] presented an elective strategy known as Computer Vision (CV) to assess the distinctive quality boundaries of muscle food sources. There are a few advantages to CV over customary procedures. It is non-dangerous, basic, and fast, and accordingly more fruitful in deciding the nature of meat. The objective of this exploration is to research the diverse quality attributes of some CV-utilizing muscle food sources.

Taheri-Garavand et al. [9] gave a designing answer for keen newness arrangement in like manner carp. It offers a valuable execution of PC vision as a team with man-made consciousness methods to appraise fish newness. It incorporates the general interaction Collection of pictures, pre-handling strategies, channel estimations, Extraction of elements, crossover set of elements.

Zhong N et al. [10] tracked down that ghastly information, yet in addition picture information was successful in foreseeing salmon newness. As needs are, another way to deal with deciding the newness of salmon by intertwining spectra and picture information was proposed in this paper. Salmon RGB pictures of different stockpiling times were diminished by the fundamental part dimensionally by utilizing Principle of part Analysis (PCA) calculation. The outcomes show that 92.3% predict accuracy.

Iswari, Ni et al. [11] technique for arranging the newness of fish dependent on the picture of the fish was proposed. In view of the synopsis of fish picture tones, KNN was utilized as the arrangement calculation. The order precision accomplished by utilizing kNN[13,14,15] was 91.36 %. This implies that the last method was viable. In the interim, the dark shade of the fish eyes was demonstrated to be the main factor in deciding the newness of the fish.

Xiaoxue Wu et al. [12] proposed a methodology wherein the surface features of the fish body were gathered and were investigated first, trailed by the features of the experience of faint characteristics for the eye iris picture. The consolidated component vectors of these two features were additionally used to accomplish newness recognition. The technique was tried utilizing carps that were procured aimlessly, and the area accuracy rate was 86.3 % [16,17,18].

Annals of R.S.C.B., ISSN: 1583-6258, Vol. 25, Issue 7, 2021, Pages. 1341 - 1349
Received 05 May 2021; Accepted 01 June 2021.

Liang Yu et al. [13] have effectively accomplished a fast technique to decide the newness of fish by utilizing a distinguishing system with an ultrasensitive amine gas sensor to recognize the shaky amine gas from rough fish meat. At the point when regular titration technique finds an approach to test the absolute erratically of essential nitrogen as a general norm for point freshness.

Dataset Description

The dataset is collected from various aquaculture industries. This consists of 300 fish images with the JPG and PNG format. These fishes are gathered from the fish markets from various cities in India. For the training, 140 images are used and for the testing, it is up to 160 images. Among these 160 images 133 images are spoiled, 27 are fresh images.

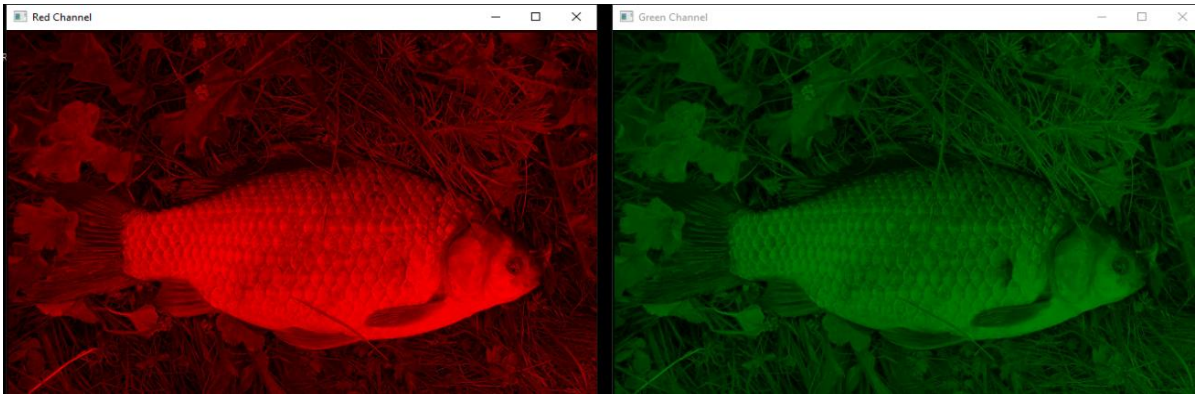

Figure 2: Representation of Fishes

Shallow DCNN

This paper mainly focused on finding the fresh and spoiled fishes from the selected datasets. The proposed system is called as shallow DCNN is introduced and this consists of feature layer and is developed with convolutional filtering and average pooling. By using the local contrast normalization the fish images are pre-processed. Then the patches are identified in the fish image by using random cropped for feature extraction. In the last stage, several features are given as inputs to calculate the MLP score for prediction. The following steps are used to process the fish images.

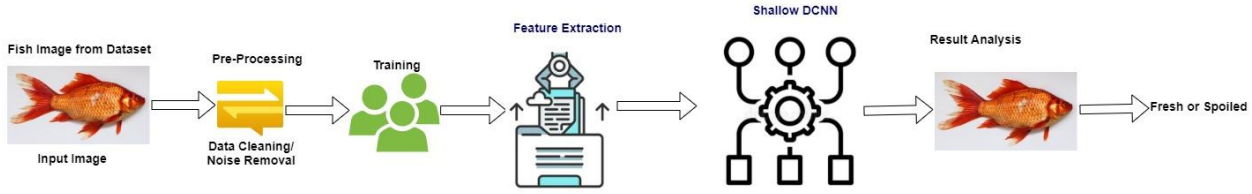

Figure 3: Deep CNN (Feature Extraction) and Classification

Steps for Algorithm:

In Step 1, the 224*224 RGB image is given as input to VGG based ConvNet. The pixel value ranges from 0-255 for fish image and subtracts the mean image values that measure the overall ImageNet training set.

Annals of R.S.C.B., ISSN: 1583-6258, Vol. 25, Issue 7, 2021, Pages. 1341 - 1349
Received 05 May 2021; Accepted 01 June 2021.

Step 2, by using the weighted layers the input fish image is preprocessed. By using the convolution layers the training images are passed with a stack. In this architecture there are 13 convolutional layers and 3 fully connected layers in VGG16 architecture. In this architecture, small filters (3*3) are present which is replaced with large filters. The filters are used to find the accurate fish freshness is implemented with sigmoid function. This function can solve the issues like binary classification. The output of this function is either 1 or 0. The representation of sigmoid function is defined as:

$$y = \frac{1}{1 + e^{-z}} \quad (1)$$

In step 3, feature extraction method Local contrast normalization is used decode relating effect in fish image analysis by applying a local non-linear operation to remove local effects.

$$z = w^T x + b \quad (2)$$

Where ‘w’ is the weight matrix and ‘b’ is a bias. These parameters are initialized as weights and bias.

Weight ‘w’ is significant feature. Generally it initializes the non-zero random value.

The bias is the constant value that will intercept to a linear equation. This will gives extra energy to the neural network to increase the fit. The bias is initialized to 0.

In step 4, every patch randomly cropped in the pre-processed image is passing through convolutional filtering and pooling to detect the destruction or not. The pooling function is represented as:

$$Y_{kab} = \max_{(x,y) \in \Re_{ab}} x_{kxy}, \quad (3)$$

Here, k is feature map,

Y_{kab} and x_{kxy} defines the location of the element (x, y). the pooling region is defined as $\Re_{ab}$ Which embodies a receptive field around the position (a, b).

In step 5, confusion matrix results are shown in table-1.

Experimental Results

The experimental results are conducted by using python programming language with 8 GB Ram and 1 TB hard drive to achieve the better performance to overcome the various overloading issues. Python has powerful libraries such as pandas, sklearn and keras are used to process the fish images.

Performance Analsysis

The performance analysis is mainly focused calculated by using confusion matrix.

True positives (TP): The predicted fish freshness is yes (fish is spoiled), and it is spoiled.

Annals of R.S.C.B., ISSN: 1583-6258, Vol. 25, Issue 7, 2021, Pages. 1341 - 1349
Received 05 May 2021; Accepted 01 June 2021.

True negatives (TN): The predicted fish freshness is no (fish is fresh), and they didn't spoiled.

False positives (FP): The predicted fish freshness is yes, originally they didn't spoiled.

False negatives (FN): The predicted fish freshness is no, but the fish is spoiled.

Table 1: Shows the confusion matrix values

	TP	TN	FP	FN
SVM	108	7	30	15
DCNN	122	12	16	10
SD-CNN	128	8	12	12

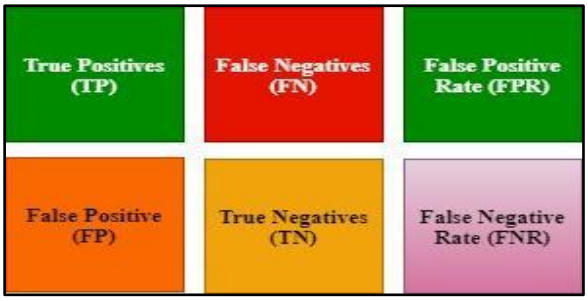

Figure 4: Confusion Matrix

	Precision	Accuracy	Recall
SVM	85.21	71.87	83.05
DCNN	91.11	83.75	92.42
SD-CNN	94.11	85	80

Table 1: Shows the comparison among the existing algorithms

Precision: The overall positives are identified accurately to measure sensitivity. This shows the precision is more potential to get positive results.

$$\textbf{Precision} = \frac{\text{No. of TP}}{\text{No. of TP} + \text{No. of FP}}$$

The performance is calculated by using the several parameters. To analyze the fish freshness, the precision is a parameter if the predictions of actual class are true. If the precision is low, only few

Annals of R.S.C.B., ISSN: 1583-6258, Vol. 25, Issue 7, 2021, Pages. 1341 - 1349
Received 05 May 2021; Accepted 01 June 2021.

positive predictions are true and if the low recall occurs then the overall fish freshness are never predicted.

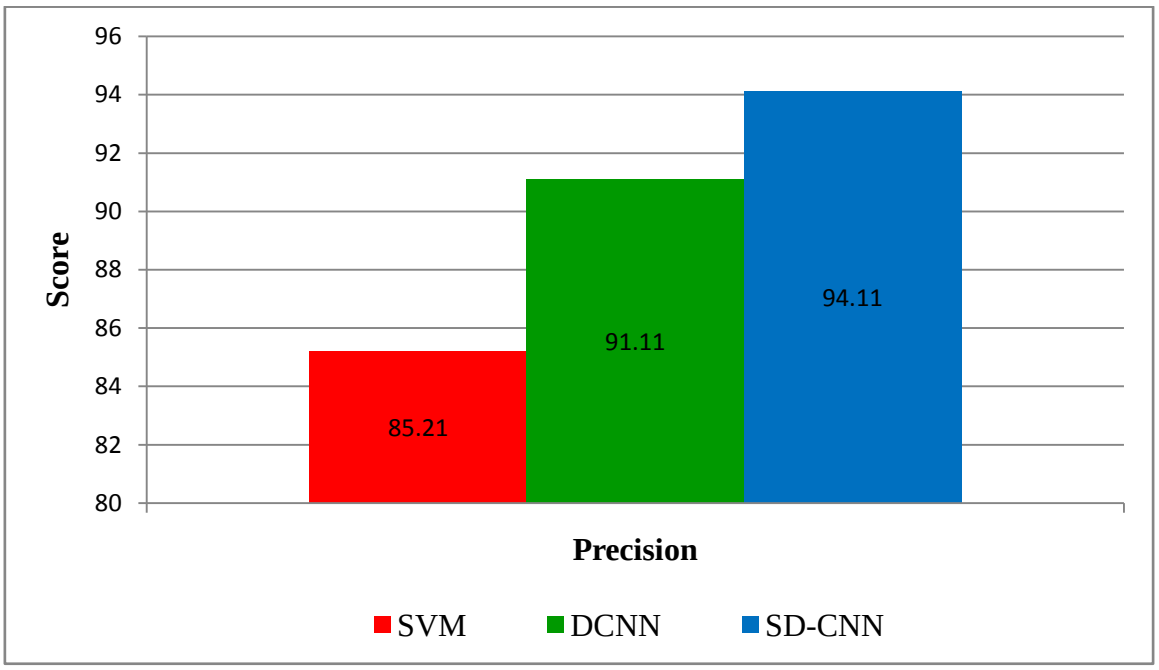

Figure 5: Precision Prediction

Accuracy: The overall accuracy is calculated by this measure.

$$\textbf{Accuracy} = \frac{\text{TP} + \text{TN}}{\text{TP} + \text{TN} + \text{FP} + \text{FN}}$$

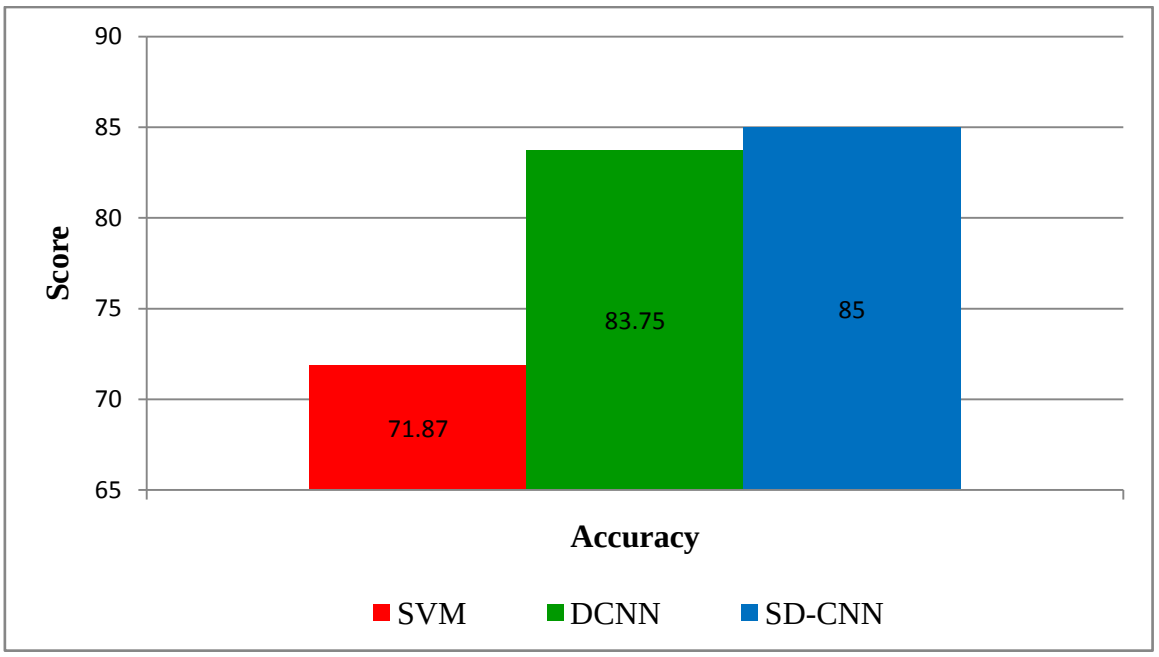

Figure 6: Accuracy

Annals of R.S.C.B., ISSN: 1583-6258, Vol. 25, Issue 7, 2021, Pages. 1341 - 1349
Received 05 May 2021; Accepted 01 June 2021.

Recall: This measures the overall true positives that are found.

$$\textbf{Recall} = \frac{\text{No of TP}}{\text{No of TP} + \text{ No of FN}}$$

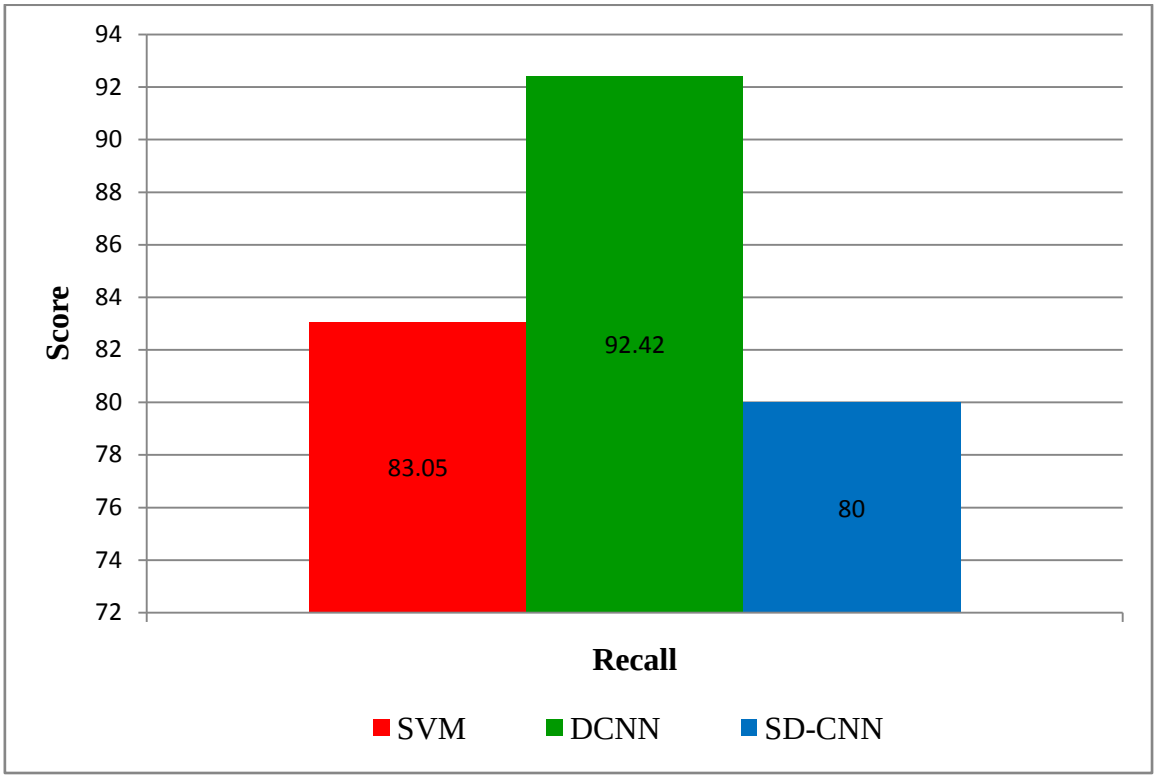

Figure 7: Recall Prediction

Conclusion

In this paper, the proposed system SD-CNN is used to find the accuracy of fish freshness and spoiled. Compare with the existing approaches such as SVM, DCNN the SD-CNN shows the huge performance in terms of all the parameters such as accuracy, precision, and recall. The training with VGG-16, pre-processing and feature extraction are most widely used in this SD-CNN to overcome the accuracy issues in existing approaches. The sigmoid function is also used to improve the performance of the proposed system. The overall accuracy achieved by the SD-CNN is 97.76 %, Precision is 97.06 and Recall is 0.96. These are very accurate and huge values to detect the freshness of the fish.

References

[1] Winiarti, S., F. I. Indikawati, A. Oktaviana, and H. Yuliansyah. "Consumable Fish Classification Using k-Nearest Neighbor." In IOP Conference Series: Materials Science and Engineering, vol. 821, no. 1, p. 012039. IOP Publishing, 2020.

[2] Agueria, Daniela, Pablo Sanzano, Paulo Vaz-Pires, Edgardo Rodríguez, and María I. Yeannes. "Development of quality index method scheme for common carp (cyprinus carpio) stored in ice: shelf-life assessment by physicochemical, microbiological, and sensory quality indices." Journal of Aquatic Food Product Technology 25, no. 5 (2016): 708-723.

[3] Lalabadi, Hosna Mohammadi, Morteza Sadeghi, and Seyed Ahmad Mireei. "Fish freshness categorization from eyes and gills color features using multi-class artificial neural network and support vector machines." Aquacultural Engineering 90 (2020): 102076.

[4] Navotas, Ian C., Charisse Nadine V. Santos, Earl John M. Balderrama, Francia Emmanuelle B. Candido, Aloysius John E. Villacanas, and Jessica Velasco. "Fish identification and freshness classification through image processing using artificial neural network." ARPN Journal of Engineering and Applied Sciences 13, no. 18 (2018): 4912-4922.

[5] Abbas, Kassim A., A. Mohamed, B. Jamilah, and M. Ebrahimian. "A review on correlations between fish freshness and pH during cold storage." American journal of biochemistry and biotechnology 4, no. 4 (2008): 416-421.

[6] Dutta, Malay Kishore, Ashish Issac, Navroj Minhas, and Biplab Sarkar. "Image processing based method to assess fish quality and freshness." Journal of Food Engineering 177 (2016): 50-58.

[7] Ibrahim, Abdelhameed, Ali Ahmed, Sherif Hussein, and Aboul Ella Hassanien. "Fish image segmentation using salp swarm algorithm." In International Conference on advanced machine learning technologies and applications, pp. 42-51. Springer, Cham, 2018.

[8] Taheri-Garavand, Amin, Soodabeh Fatahi, Mahmoud Omid, and Yoshio Makino. "Meat quality evaluation based on computer vision technique: A review." Meat science 156 (2019): 183-195.

[9] Taheri-Garavand, Amin, Soodabeh Fatahi, Ashkan Banan, and Yoshio Makino. "Real-time nondestructive monitoring of Common Carp Fish freshness using robust vision-based intelligent modeling approaches." Computers and Electronics in Agriculture 159 (2019): 16-27.

[10] Wu, Ting, Ling Yang, Juan Zhou, Dong Cheng Lai, and Nan Zhong. "An improved nondestructive measurement method for salmon freshness based on spectral and image information fusion." Computers and Electronics in Agriculture 158 (2019): 11-19.

[11] Iswari, Ni Made Satvika. "Fish freshness classification method based on fish image using k-Nearest Neighbor." In 2017 4th international conference on new media studies (CONMEDIA), pp. 87-91. IEEE, 2017.

[12] Gu, Jun, Nan He, and Xiaoxue Wu. "A new detection method for fish freshness." In 2014 Seventh International Symposium on Computational Intelligence and Design, vol. 2, pp. 555-558. IEEE, 2014.

[13] Chang, Liang-Yu, Ming-Yen Chuang, Chia-Jung Lu, Ping-Hung Yeh, and Jian-Nan Chen. "One-minute fish freshness evaluation by testing the volatile amine gas with an ultrasensitive porous-electrode-capped organic gas sensor system." ACS sensors 2, no. 4 (2017): 531-539.

[14] J.Nageswara Rao, M.Ramesh," A Review on Data Mining & Big Data, Machine Learning Techniques", International Journal of Recent Technology and Engineering (IJRTE) , ISSN: 2277-3878, Volume-7 Issue-6S2, April 2019.

[15] D. Veeraiah and J. N.Rao, "An Efficient Data Duplication System based on Hadoop Distributed File System,"2020 International Conference on Inventive Computation Technologies (ICICT), 2020, pp. 197-200, doi: 10.1109/ICICT48043.2020.9112567.

[16] J. N. Rao, A. C. Singh, "A novel encryption system using layered cellular automata," International Journal of Engineering Research and Applications, vol. 2, no. 6, pp. 912–917, 2012.

[17] J.Nageswara Rao, Bhupal Naik, G Sai Lakshmi, V Ramakrishna Sajja, D Venkatesulu, "Driver's Seat Belt Detection Using CNN" Turkish Journal of Computer and Mathematics Education Vol.12 No.5 (2021), 776-785 3.

[18] J.N Rao, Dr.Rambabu Busi, Dr. G Rajendra Kumar, U. Surya Kameswari, " Content image Retrieval Based on using open Computer Vision and Deep Learning Techniques "International Journal of Advanced Science and Technology,Volume29Issue03Pages5926 - 593 92020)