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Identification of Fish Freshness using Artificial Intelligence

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Abstract

Fish is the most perishable sea food and it has high economic value due to its taste and nutritional value. Nowadays, fish freshness is analyzed by physical examination test. Manual identification of fish freshness can source of false estimation and result to the probability of food poisoning. This paper deals with the classification of fish freshness based on image processing by using Artificial Neural Network (ANN). The fish eye image will be captured during its freshness stage to spoiled stage sequentially and it is stored by using chilling process. In Image acquisition, the eyes and gills of the fish image was captured under constant illumination. The images are processed and it is fed to Artificial Neural Network (ANN). Feed forward back propagation algorithm was used to train the artificial neural network in order to achieve the desired output.

Introduction

Fish freshness is the most important term used in monitoring and quality assurance of food. As fishes are exported to different countries, the fresh fishes have more demand. Providing the fresh fish to consumer also indicates a better trade practice and created a good brand. In the trade, freshness is usually judged based on the appearance, texture and odour of the raw fish. Fishes are the most vulnerable and perishable food which has wide range of health-promoting compounds. Several methods are available to evaluate the fish freshness they are physicochemical, textural, sensory and electrical methods. Therefore, the objective of quality evaluation is realized by keeping output quality at the right level of profitability can also occur when fish products do not comply with local or national regulation. One of the key factors associated to fish consumption is the people's recent interest in health, longevity, and food safety.

Such behavior has increased fish consumption patterns and the demand for product with special characteristics that influence consumers. The fish freshness depends on its appearance, odour, flavour *etc*. is shown in Figure 1.

Fish freshness evaluation method can be divided into two categories as follows.

a) Sensory evaluation method

b) Non sensory evaluation or Instrumental evaluation method

This method of sensory and non-sensory evaluation can sometimes provide false evaluation. The regular consumer cannot accurately identify the fish freshness. The image processing tools is used to analyze the freshness of the sea fish. Muhamad *et al*. (2009) developed a fish freshness monitoring detector using Fuzzy logic. The advantage using fuzzy logic is the system allows the natural description where the process of detecting the freshness of the fish is fully automated when

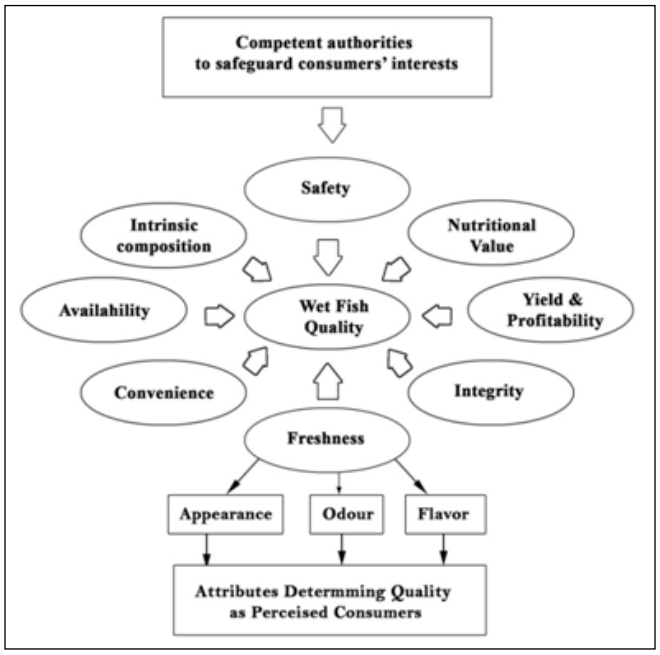

Figure 1: Characteristics Quality of Wet Fish and Component Authorities to Safeguard Consumer's Interest

the input is already obtaining. Alaimahal *et al*. (2017) designed an automatic, efficient and non-destructive image processing method using a clustering-based method. The features are extracted in the wavelet transformation domain using Haar filter. This analysis can be done on any fish species. Jun Chen *et al*. (2019) developed electronic nose for fish freshness evaluation. The electronic nose can able to distinguish pork, beef and mutton samples with different storage times.

Non-sensory assessment should give the same result no matter where they carried out, whereas sensory evaluation may depend on subjective responses of the panelists to the fish being examined. Non-sensory method can appear more objective and reliable than sensory methods, although this need not be the case. When specifications are being prepared it is easier to insert numerical limits based on non-sensory tests than on sensory test.

Methodology

The proposed system in Figure 2 operates for the identification of fish freshness using artificial intelligence. The software design of the system is discussed below.

The Milk Fish (*Chanos chanos*) is selected to analyze the freshness using Artificial Neural Networks. The image of the fish was captured by using 12 Mega pixel android smart phones. This study was carried out for twenty days. Fish preservation is carried out using chilling method between the freezing point -0.6 and -2.2 °C. The chilling process is repeated every day at regular intervals after image capturing. Then the image undergoes the process of resizing or distortion from one pixel grid to another. Image resizing is necessary to increase

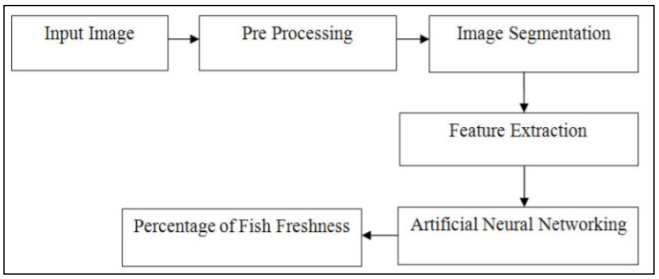

Figure 2: General Block Diagram to Identify Fish Freshness

or decrease the total number of pixels. In this process the images are resized. The eye region of the fish is cropped to calculate the required area of the eye of the fish. The cropped image is filtered to reduce the noise. In segmentation process the image feature is extracted for further processing. Feature extraction in image processing is a method of transforming large redundant data into a reduced data representation. Feature extraction is the transforming the input data into the set of features and the values are stored in the database after extraction of features. The classification of fish spoilage is done using Artificial Neural Network. The Algorithm used to identify fish freshness is Feed-forward Back propagation Neural Network algorithm.

Results and Discussion

Image Acquisition

Many digital images are captured using visible light as the energy source as shown in Figure 3. The designed system is tested for the samples of Milk Fish for 20 consecutive days. The image acquisition is done by capturing and validating using a phone camera of 12 Mega Pixel and its loaded and saved in jpg file format in MATLAB.

Figure 3: Image Acquisitions

Pre-Processing

The preprocessing of image aims at selectively removing the redundancy present in captured images without affecting the details that play a key role in the overall process. Resizing of an image is performed by the process of the interpolation. It is a process which resamples the image to determine values between defined pixels. Thus, resized image contains more or less pixels than that of original image. The intensity values of additional pixels are obtained through interpolation if the resolution of the image is increased. In this process, to obtain the required area in fish eye, the images were resized [512×512 pixels]. The resize can be done by cropping the image which is shown in Figure 4. The bilateral filtration technique is used to reduce the noise in the image for gray and color images.

Figure 4: Pre processing

Segmentation Process

Segmentation of an image is a process of dividing the image into homogenous, self-consistent regions corresponding to different objects in the image. It separates image into meaningful regions. Image can be segmented using basic properties of features of image like intensity, edge or texture. After preprocessing, segmentation is performed, to analyze the image easily. The input color image will be coarsely represented using 25 bins. Coarse representation uses the spatial information from a Histogram based windowing process. K Means is used to cluster the coarse image data. In this paper color image segmentation is used. It is based on the color feature of Image pixel as shown in Figure 5. The homogenous colors in the image correspond to separate cluster which defines a class of pixel that is similar color properties.

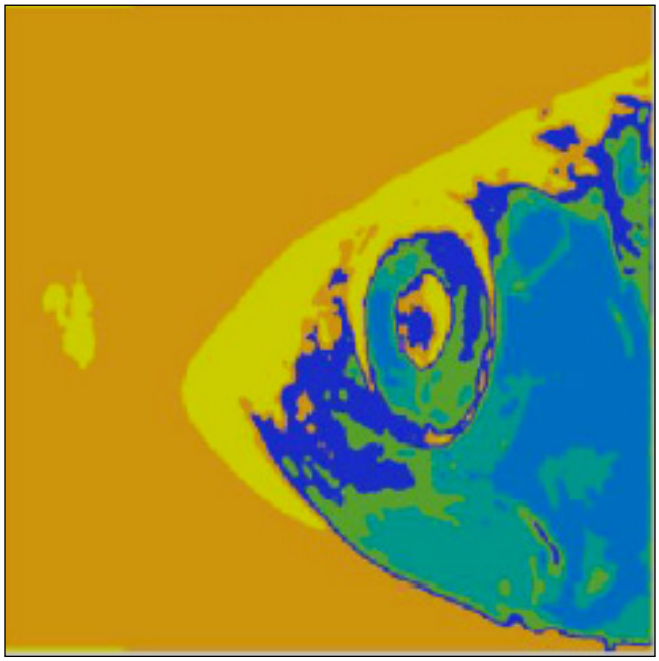

Figure 5: Segmentation Process

Feature Extraction

Feature extraction is a low-level image processing operation which is usually performed as the first operation on an image. A feature can be defined as the "interest" part of an image. The desirable property for a feature detector is repeatability; *i.e.*, whether or not the same feature will be detected in different images of the same scene. Step edges, lines and junctions usually convey the most relevant information of an image; hence, it is important to detect them in a reliable way. Feature extraction process is used followed by segmentation process. In this paper, texture analysis using the GLCMs (Gray Level Co-Occurrence Matrix). The extracted values are stored in database after feature extraction. The GLCM functions characterize the texture of an image by calculating how often pairs of pixels with specific values and in a specified spatial relationship occur in an image, creating a GLCM, and then extracting statistical measures from this matrix (the texture filter functions, described in Texture Analysis cannot provide information about shape, that is, the spatial relationships of pixels in an image). After creation of GLCMs, using grayco matrix, several statistics are derived from them using graycoprops.

Classification

The Figure 6 shows the classification of the feature extraction stage, which usually is raw pixel data, constituting either the boundary of a region or all the points in the region itself. In either case, converting the data to a form suitable for computer processing is necessary. The first decision that must be made is whether the data should be represented as boundary or as complete region. Boundary

representation is appropriate when the focus is on external shape characteristics, such as corners and inflections. Regional representation is appropriate when the focus is on internal properties, such as texture or skeletal shape. Choosing a representation is only a part of the solution for transforming raw data into a form suitable for subsequent computer processing. A method must also be specified for describing the data so that features of interest are high-lighted. Classification, also called feature selection, deals with extracting attribute that result in some quantitative information of interest or are basic for differentiating one class of object from the other.

Classification of input image is done on the basis of extracted feature from input image. We use feed forward back propagation algorithm in Artificial Neural Network to identify the object into different classes, such as Fresh, Normal, and Spoiled.

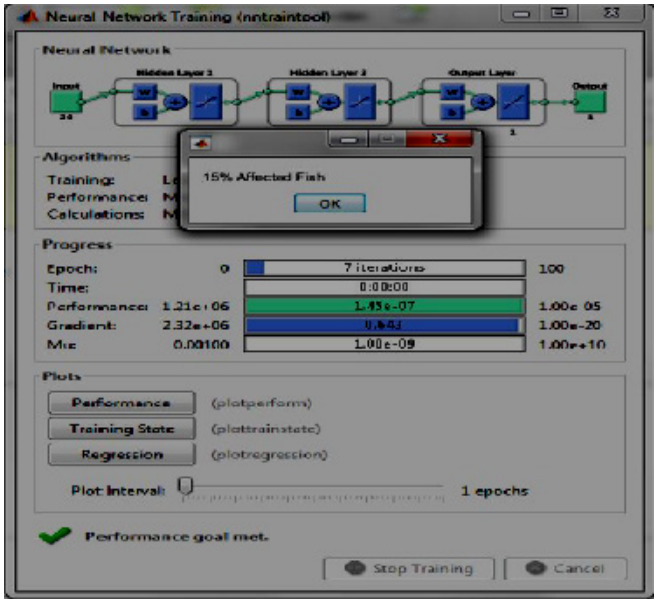

Figure 6: Classification Process

The final remarks on experimental results are as follows and the separation of the eyes of the fish image using image processing algorithm is based on feed forward back propagation Algorithm. It is the most informative regions of the images are the determination of freshness percentage. Experimental result indicates that feed forward back propagation algorithm is an efficient and accurate method for freshness identification. The reference value defined for each range helps the algorithm to classify the input samples for freshness range. Hence this method may be considered as a robust and comprehensive method for determining the fish freshness. The experimental results with 20 samples of fish images for various percentage of freshness have been tested for prediction of fish freshness and quality. Hence, this can be considered as significant method for determining fish freshness is shown in Figure 7.

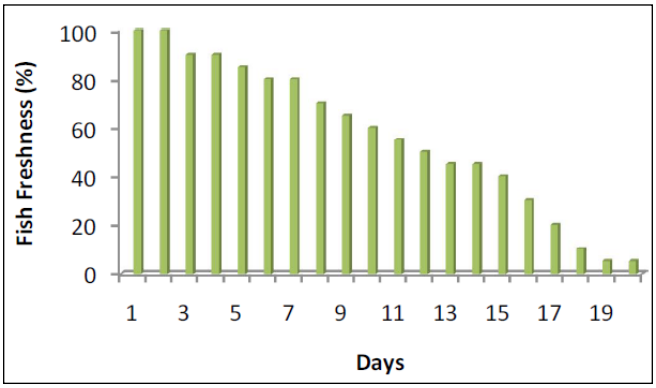

Figure 7: Determining fish freshness

Conclusion

This work deals with the nondestructive image processing based method for predicting the percentage of freshness in the fish. The perceptible changes in the automatically segmented eyes have been used in Feed Forward back propagation algorithm as discriminatory features. The decomposition of segmented eyes is determined using bilateral filter. It has been used for horizontal coefficient to have a discriminative behavior with the number of days preserved. A relationship between eye feature and freshness level is established from the training data and based on this relationship fish freshness is identified from the images. This framework may be considered significant and the prototype finds application in fish industries and for consumers.

As a future perceptive of this work, the current methodology may be applied for different organs and for different fish varieties. And also, a bar code based reader may be designed for indicating the quality and freshness in big supermarkets.

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