PISCIS FRESHNESS DETECTOR

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***Abstract*— PISCIS (Fish) is an essential part of the human diet since ancient times. Rapid detection of fish freshness is very important for processing and storage. But now fish freshness detection is more difficult due to the usage of Ammonia and Formalin. By focusing on the demerits of existing fish freshness techniques, a quick and precise method is proposed in this paper. Here two sensors MQ-137 and MS-1100 are used to determine the presence of Ammonia and Formalin. Adaptive thresholding and Hough transform are used to determine the freshness of fish. And the classification process categorizes the images into fresh or stale on the basis of texture features. At last LED displays weight (in kg), amount of Formaldehyde and Ammonia contaminated on it. Also the device displays whether the fish is fresh or not. Hence, this application will ensure the quality of fish before consuming.**

***Index Terms*—Fish freshness, sensors, digital image processing**

I.INTRODUCTION

Fish is the most important food source in daily life and it has high nutritional content. Fish may be taken as medicine for many reasons. But the consumption of stale fish causes different types of diseases inside and outside the body. So the detection of fish freshness is very important. The main focus of this work is to determine fish freshness. Many types of existing methods are there for detecting freshness of the fish[1]. One of them is Torrymeter, in which dielectric properties exist in the fish skin and muscles are taken for the detection. But the Torrymeter is very expensive. It is not affordable by common people. Another method is by using an array of chemical sensors. But it needs more sensors. Electronic tongue methods have liquid as a sample for detection. These types of existing technologies have very limited range of accuracy. Fish freshness is one of the fundamental factors of fish quality and depends on different biological and processing factors. It indicates the degree of various physical, chemical, biochemical and microbiological changes in fish. Freshness assessment methods correlate the measurement of fish freshness according to the elapsed time after being caught. These methods measure the freshness by appearance, odour, colour, texture and so on.

Traditionally, freshness has been assessed by sensory methods i.e. using the human senses of sight, smell and touch [2]. This approach gives an immediate appraisal of quality and can be done without damage to the fish. However, there are some difficulties. Trained and experienced persons are required, and this training takes a long time. It is not easy to make sensory assessment quantitative. The changes occurring during spoilage can be described and codified, but individuals may interpret these descriptions somewhat differently. This makes it difficult to establish standards that can be applied in different locations, and by different assessors. There is therefore a need for objective methods for measuring freshness that do not depend on the subjective opinion of human judges. In this project load cells with two sensors mainly MQ-137 for Ammonia detection and MS-1100 voc sensor for Formalin are used. Then a Raspberry pi with cam is attached for analyzing the change of colour in the fish eye and its body. For processing, output is connected to Raspberry pi. A LED is used to display the weight of the fish and how much content of Ammonia or Formalin is deposited on it.

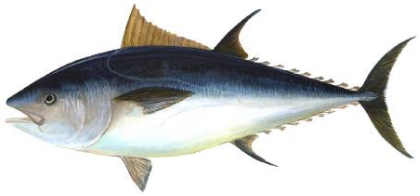


Fig 1: Fresh tuna fish. [Courtesy-. Wikipedia)

II. LITERATURE SURVEY

Regarding on fish freshness detection, the fish quality measurement is improvised each year with various methods to get a better result. Chemical methods are usually more precise but they are time consuming and expensive.

A related paper of a team from university technology MARI Malaysia provides a review of "Comparison of fish freshness determination method". Two methods are used to detect fish freshness which are Torrymeter and Quantification of RGB colour indices. Torrymeter manipulates the dielectric property existing in the fish skin and muscle alteration systematically as the tissue component degrades, while quantification of RGB colour where the mean values of RGB reflectance colour space characterize and relate with qualities of fish. This study evaluates the relation between fish freshness from various species by using the comparative study in determination of fish freshness [3].

The challenging research topic "Intelligent processing of E-Nose information for fish freshness" assessment requires a deep study of type of sensors, advanced signal processing and pattern recognition method. Electronic noses can be used to identify odour varieties. This study estimates the freshness of fish and predicts how fast it degrades in a given environment[4].

According to a research paper, "Fish freshness assessment by using electronic nose" relates the detection of the freshness of fish by using an electronic nose composed of eight metal oxide sensors. Here three classification algorithms compared with each other. Decision tree structure gives the better result. The proposed algorithm consists of combining SVM and k-NN algorithm [5].

In paper "Fish Freshness testing with Artificial Neural Network" uses an electronic nose which has eight metal oxide gas sensors. To increase the classification success, activation functions and input data obtained from different feature extraction methods was changed. The storage condition is a very important factor for fish freshness and fishes used in this study were stored at fish market condition [6].

In a "Detection method for Fish Freshness", the statistic feature of gray values for eye iris image and surface texture features of fish body were obtained and down sampled. Finally, the combined feature vectors by these features were used to accomplish the freshness detection. The method was verified by using carcs randomly purchased and the detection accuracy rate got 86.3% [7].

In "Multi-point ATP sensing for rapid precise fish freshness check", a microfluidic device was developed for on-sight checking of fish freshness. Sample solutions and an enzyme substrate were handled in the form of plugs formed in a network of flow channels. To simplify the structure, a wider portion was formed in a flow channel to merge the plugs. ATP was detected using two enzymatic reactions involving glycerol, kinase and glycerol-3 phosphate oxidase[8].

III. EXISTING SYSTEM

ICAR- Central Institute of Fisheries Technology has developed a paper strip Formaldehyde and Ammonia in fishes. This detection method is based on visual observation of colour development. There are two separate kits for detecting the presence of Formalin and Ammonia in fishes. The strip has to be scraped on the surface of the fish. Then 1-2 drops of the reagent solution is added and a colour change is occurred. In the case of Formalin the colour change appears on the strip is light pink. In the absence of formalin the strip turns green by adding a reagent and then it becomes deep blue. Disadvantages of the system is time consuming and erroneous[9].

Torrymeter is an instrument used to measure fish freshness. It consists of two pairs of concentrically arranged electrodes. An alternating current is passed through the fish between the outer pair of electrodes and the voltage is sensed by the inner pair. There are two types of scale provided to indicate the fish freshness which are 1 to 16. The dielectric properties existed in fish skin and muscle alteration systematically as the tissue component degraded. It is strongly related with the rapid changes in order, appearance, flavor and texture that happened to the fish during spoilage. Hence, the determination of the dielectric property set a measurement of the fish freshness. Disadvantages of this technique are not accurate, do not show the presence of Formalin and Ammonia and are very expensive[10].

IV. PROPOSED SYSTEM

This project is a real time application system aimed to detect the freshness of fish. This product identifies the Ammonia and Formalin content in the fish. It also measures the weight of the fish. The project is a combination of hardware and software. In the hardware part, sensors are used for the detection process. MS-1100 is a Formaldehyde sensor[20] and MQ-137 is a Ammonia sensor[21], those are used for the detection of chemicals. A weight sensor is included for measuring the weight of the fish. These three sensors are interfaced with Nod-32[22]. Amplifier module is connected to a microcontroller for amplifying the signal from the weight sensor.

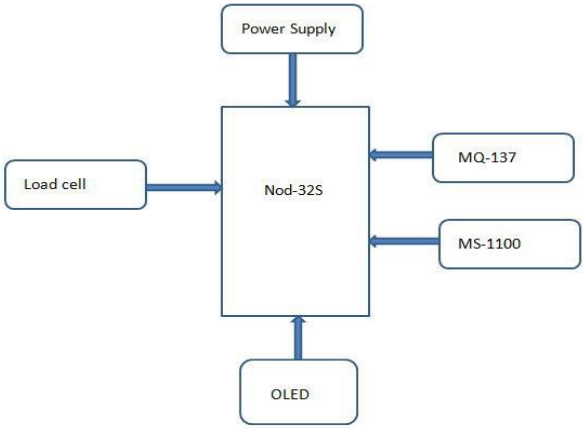


Fig 2. Interfacing of sensors with Nod-32

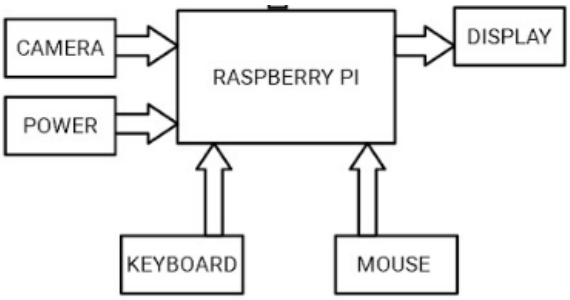


Fig 3: Architecture of Image Processing System

The second part consists of a pi cam which has direct connection with raspberry pi. This pi cam is used to take real time pictures. It undergoes several image processing techniques such as preprocessing, segmentation, feature

extraction, classification. Picture taken from the pi cam is used as an input image. Then preprocessing that image and adaptive thresholding is carried out. After that, Hough Transform is applied on it. The KNN classifier is used in the classification process. OLED displays the weight, chemical content, fresh or not fresh fish.

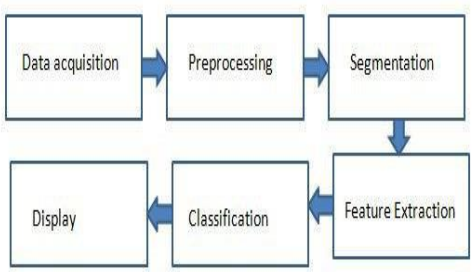


Fig 4: Functional block diagram of image processing

V. METHODOLOGY

A. Pre-processing

These are the steps in image processing. First preprocess the input image. It included reshaping and Gaussian filter. Reshaping will improve the image data that suppress the unwanted distortions and enhances image features. If increasing or decreasing the total number of pixel images, reshaping is necessary. The Gaussian filter is a linear filter. It's usually used to blur the image or to reduce noise[12]. The Gaussian filter will blur edges and reduce contrast. The Median filter is a non-linear filter that is most commonly used as a simple way to reduce noise in an image. It removes noise while keeping edges relatively sharp. The advantage of Gaussian filter over other filters is that it's faster because multiplying and adding is probably faster than sorting[13].

(a) (b)

Fig 5. (a) Original image (b) After pre processing

B. Image segmentation

Image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as image objects). The goal of segmentation is to simplify and change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics. Here image segmentation is done by using adaptive thresholding. The image is fully thresholding, classifying the pixels as either dark or light. It is the spatial variations in illumination. In Adaptive thresholding the input is gray or color image, the output will be in binary representation of image[14].

Image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image. Each of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristics[15].

(a) (b)

Fig 6.(a) Pre-processing image (b) After segmentation

C. Feature extraction

Feature extraction starts from an initial set of measured data and builds derived values (features) intended to be informative and non-redundant, facilitating the subsequent learning and generalization steps, and in some cases leading to better human interpretations. Feature extraction is related to dimensionality reduction[16].

When the input data to an algorithm is too large to be processed and it is suspected to be redundant(e.g. the same measurement in both feet and meters, or the repetitiveness of images presented as pixels), then it can be transformed into a reduced set of features (also named a feature vector).The Hough transform is a feature extraction technique used in image analysis, computer vision, and digital image processing. The purpose of the technique is to find imperfect instances of objects within a certain class of shape. The Hough transform was concerned with the identification of lines in the image, but later the Hough transform has been extended to identifying positions of arbitrary shapes, most commonly circles or ellipses. In gray images, the size and difference of pixel value in eye iris regions could reflect the color of the iris. Then the mean and standard deviation of all pixel values in eye iris is extracted[17].

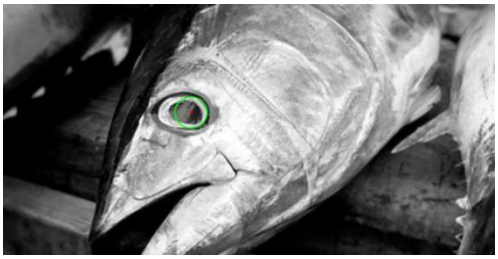


Fig 7. Feature extraction

D. Classification

Classification includes a broad range of decision-theoretic approaches to the identification of images. The classes may be specified a priori by an analyst (as in supervised classification) or automatically clustered (i.e. as in unsupervised classification) into sets of prototype classes. In pattern recognition, the k-nearest neighbours algorithm (k-NN) is a non-parametric method used for classification and regression. In both cases, the input consists of the k closest training examples in the feature space. The output depends on whether k-NN is used for classification or regression. In k-NN classification, the output is a class membership. This value is the average of the values of k nearest neighbors[18][19].

V. RESULT AND DISCUSSIONS

Fish is placed on a sheet at the top of the load cell. OLED displays the fish weight in gram by using the weight sensor. Other two sensors identify whether the fish contains Ammonia and Formalin.After identification, OLED displays chemical content deposited in ppm. Camera takes the real time images of fish in the load cell. When image processing techniques are applied on the input fish through preprocessing resizing is done. Adaptive thresholding technique is used in the segmentation process. In this step the gray image is converted into a binary image. During thresholding if the input fish is fresh, then the separation of foreground and background image can be seen clearly. Next process is feature extraction. Hough Transform is used to identify the circular shape in the fish eye. Fresh fish is to identify the circular shape and red colour is not detected. In stale fish, circular shape is not detected and red colour in the eyes is very clear. Classification process categorizes the images into fresh or stale on the basis of texture features.

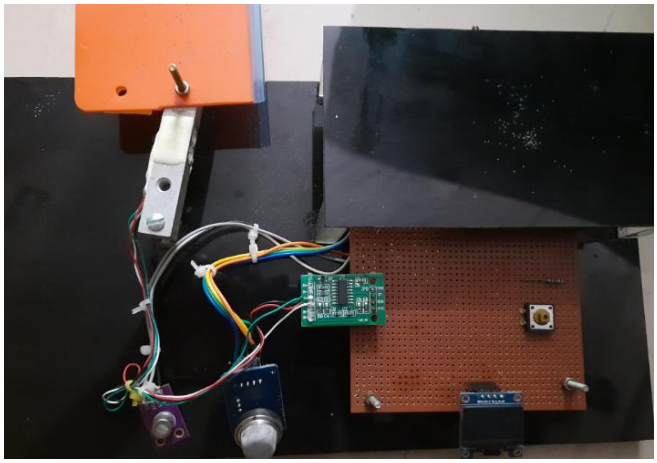


Fig 8 . Hardware Setup

Fig 9: Sensor Arrangements

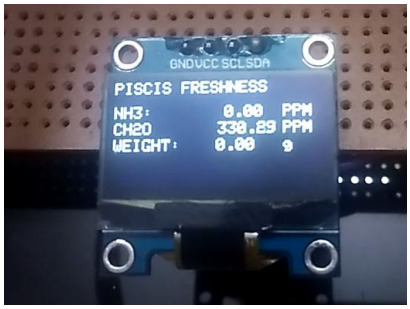
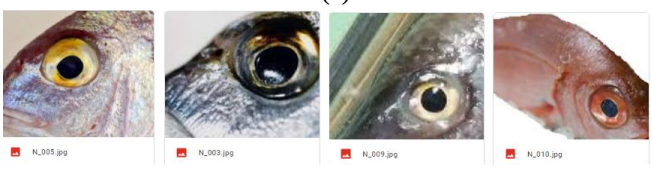


Fig 10 . Hardware Display

(a)



(b)

Fig 11: Dataset (a) Fresh (b) Not Fresh

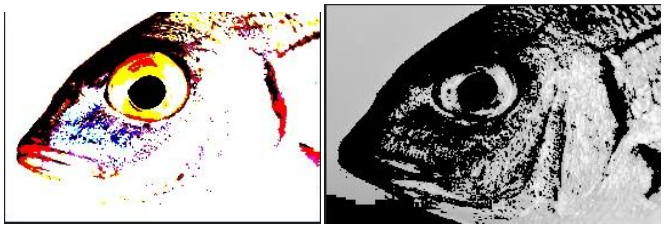


Fig 12: Different levels of Segmentation

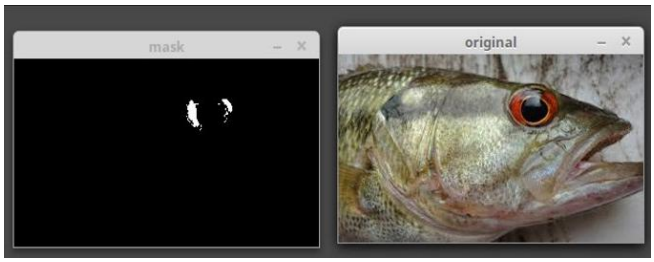


Fig 12: Thresholded eye mask

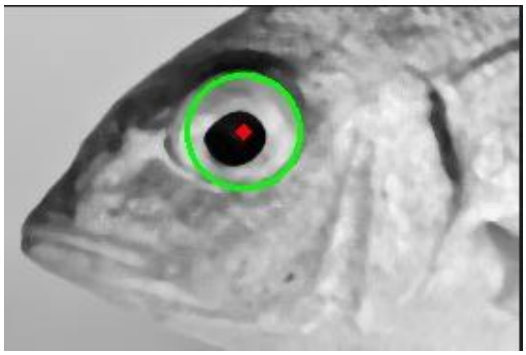


Fig 13: Eye Detection

Fig 14: Classification (a) Fresh (b) Not Fresh

VI. CONCLUSION

Fish is a food of excellent nutritional value, providing high quality protein and a wide variety of vitamins and minerals. Study on the rapid detection of fish freshness is very important for processing and storage of fish. Commonly, after the fish dies, fish muscles will undergo alternation where sensory characteristics will change according to the number of microorganisms on the fish flesh and skin. These will result in progressive loss of food characteristic in terms of taste, appearance and general concept of quality. This paper, analysed advantages and disadvantages of present fish freshness technique. On the basis of this, a detection technique based on sensors and image processing was put forward. Here two sensors MQ-137 and MS-1100 are used to detect the presence of Ammonia and Formalin. Then the change in iris and fish body surface texture were combined to achieve the detection. The experimental result shows that this method can achieve accurate fish freshness detection rapidly and non-destructively. This project mainly focused on welfare and health of the people. No scientific knowledge is required for the working, so it is a user friendly product.

VII. REFERENCES

[1] Usydus Z, Szlinder-Richert J. Functional properties of fish and fish products: a review[J]. International Journal of Food Properties,2012,15(4): p823-846.

[2] Cheng-Ta Chiang and Lian-Teng Lin," A CMOS Fish Freshness to Continuous-Time Incremental
Sigma-Delta Modulator for Monitoring Fish Freshness in Fish Markets", IEEE International
Conference, Aug.2019.

[3] RoziahJarmin, Lee YootKhuan, HadzliHashim and NurHidayah Abdul Rahman," A Comparison on Fish Freshness Determination Method ", International Conference on System Engineering and Technology, Sept 11-12. 2012.

[4] H. GholamHosseini1, Dehan Luo2, Hongxiu Liu2, Guanggui Xu2," Intelligent Processing of Enose Information for Fish Freshness Assessment ", IEEE, 2007

[5] Jun Gu," A New Detection Method for Fish Freshness", Seventh International Symposium on Computational Intelligence and Design, 2014.

[6] Ayten Atasoy1, Umit Ozsandikcioglu1, and Selda Guney2," Fish Freshness Testing with Artificial
Neural Networks ".

[7] Cheng-Ta Chiang, Yen-Kuei Lu, and Lian-TengLin," A CMOS Fish Resistance to Period Converter with Calibration Circuits for Fish Spoilage Detecting Applications ", IEEE International Conference,Aug.2017.

[8] Ashish Issac1, Malay Kishore Dutta1, "An Efficient Image Processing Based Method for Gills
Segmentation from a Digital Fish Image", IEEE International Conference, 2016.

[9] ER Priya, SJ Laly, SK Panda , S.K. and Ashok Kumar K. "Rapid detection kits (CIFtest Kits) to check adulteration of formaldehyde and ammonia in fresh fish" ICAR-Central Institute of fisheries technology cochin , FishTech Rep. 4 (1), January-June 2018

[10] Pengxiang Yuan, Yao Wang, Riho Miyazaki, Jia Liang, Katsuya Hirasaka, Katsuyasu Tachibana, Shigeto Taniyama, A convenient and nondestructive method using bio-impedance analysis to determine fish freshness during ice storage, Fisheries Science, 10.1007/s12562-018-1256-8, 84, 6, (1099-1108), (2018).

[12] Hanna A. Hakkim, "Automated Detection and Classification of Exudates in Retinal Images Using Discrete Wavelet Transform and Artificial Neural Network", IJIIE-

International Journal of Innovations & Implementations in Engineering (ISSN 2454- 3489) 2016 July Vol. 1
[14] Neethu S., "Advanced Registration Plate Recognition Algorithm With Video Image De-hazing", IJIIE-International Journal of Innovations & Implementations in Engineering (ISSN 2454- 3489) 2016 July Vol.1
[15] Anusree D., "A Novel Algorithm for Shadow Detection And Reconstruction in High-Resolution Satellite Images", IJIIE-International Journal of Innovations & Implementations in Engineering (ISSN 2454- 3489) 2016 January Vol. 1
[16] Meera S. Nair, "Automated Human Colorectal Polyp Detection in Colon Capsule Endoscopy", IJIIE-International Journal of Innovations & Implementations in Engineering (ISSN 2454-3489)2016 January Vol. 1
[17]A. Mohan, D. Madhu, J. Tayalekshmy, A. R.P and J. Raju, "Efficient algorithm for object detection using saliency feature in machine vision systems," 2019 2nd International Conference on Intelligent Computing, Instrumentation and Control Technologies (ICICICT), Kannur,Kerala, India, 2019, pp. 1527-1531, doi: 10.1109/ICICICT46008.2019.8993308.
[18] Anju. C. Achankunju 'A Novel Algorithm for Gender prediction Using Facial Features'- IJIIE-International Journal of Innovations & Implementations in Engineering (ISSN 2454- 3489) 2016 April Edition Volume 1.
[19] Anusha A V "Facial expression recognition and gender classification using facial patches" ,IEEE 2016 International Conference on Communication Systems and Networks (ComNet) | 21-23 July 2016 | Trivandrum.
[20] ETC,MS-1100,Formaldehyde sensor , datasheet
[21] Hanwei, MQ-137, Ammonia Sensor , datasheet
[22] Espressif, ESP32S , datasheet ,

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