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இலங்கை தொழில்நுட்ப பல்கலைக்கழகம்

Assessment of Fish Quality Through Multispectral Imaging

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Outline of the Presentation

- Fish Quality Assessment.

- Multispectral Imaging for Food Quality Analysis.

- Proposed Multispectral Imaging System.

- Sample Preparation and Image Capturing

- Proposed Image Processing Algorithm.

- Results and Conclusion.

Fish Quality Assessment

Conventional Detection Method

- Through human inspection.
- Need to develop a standard method to determine fish quality.

Disadvantages of Conventional Detection Methods

Time Consuming

Need human inspection

Human Dependent

Highly Laborious

Multispectral Imaging for Food Quality Analysis

Multispectral Imaging is used to

- Detect Adulteration Levels of Spices.
- Detect Contamination of Meat.
- Identify the Adulteration Level of Edible Oils

Advantages of Multispectral in Food Quality Analysis

Chemical free assessment

Environmental Friendly – No Chemical Wastes

Non-destructive
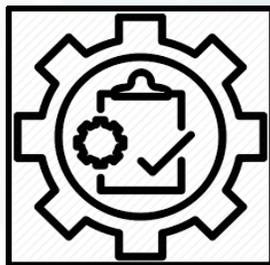
Automatable

Economical

Proposed Multispectral Imaging System
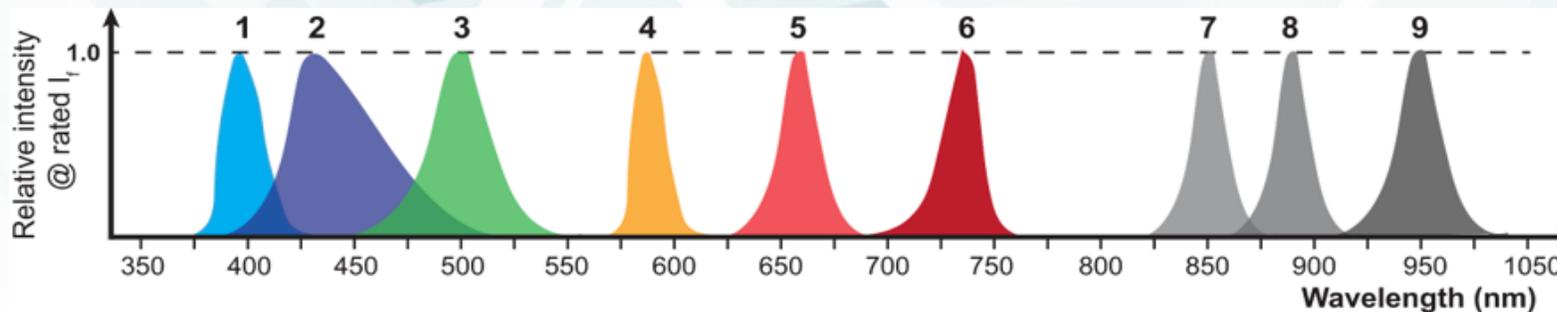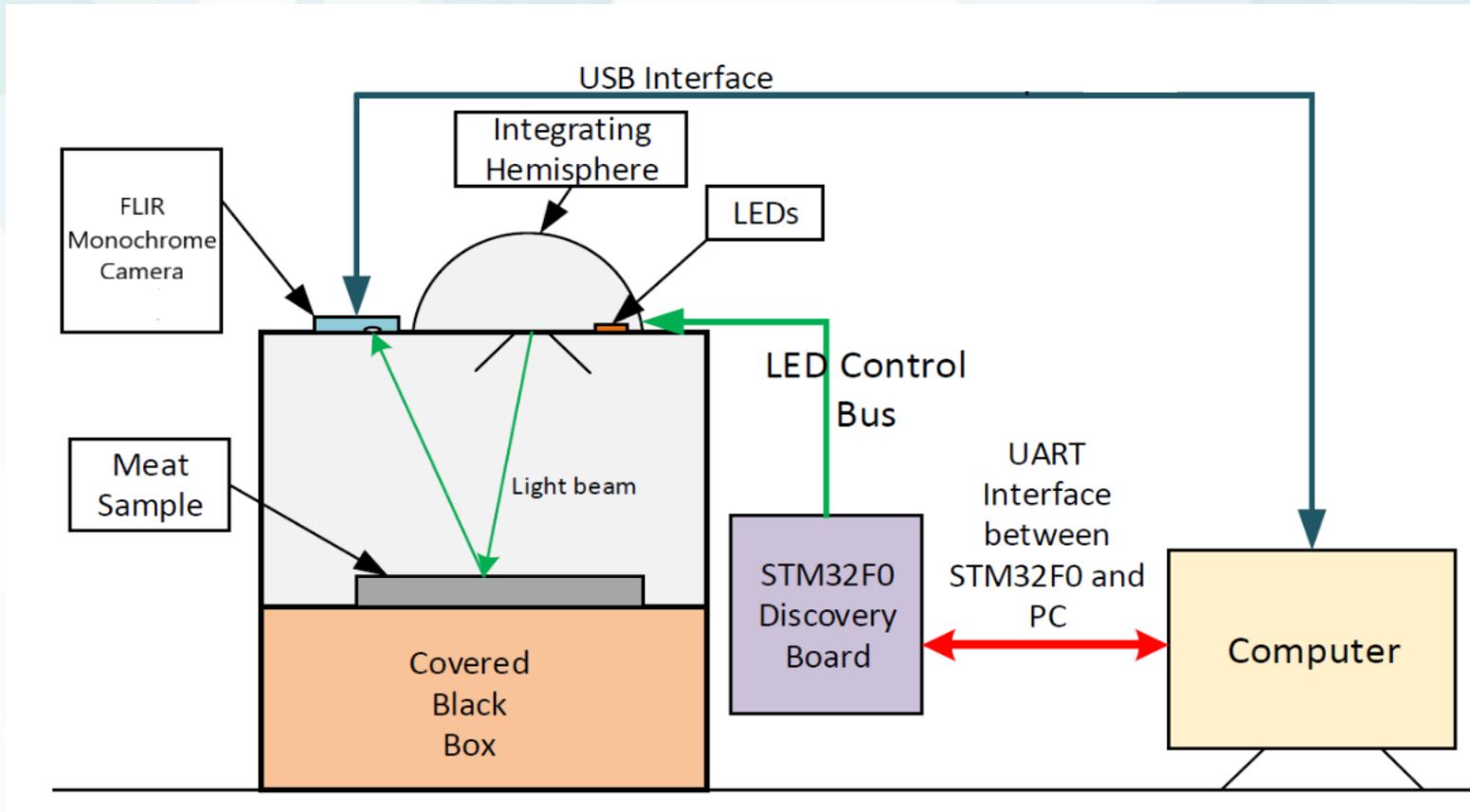
Fish Sample Preparation

- Fish samples obtained from a reputed fish exporting company.
- Fish can be graded into 6 different classes namely, A+, A, B+, B, B-, C.
- The samples were taken only from the 'TUNA' fish.
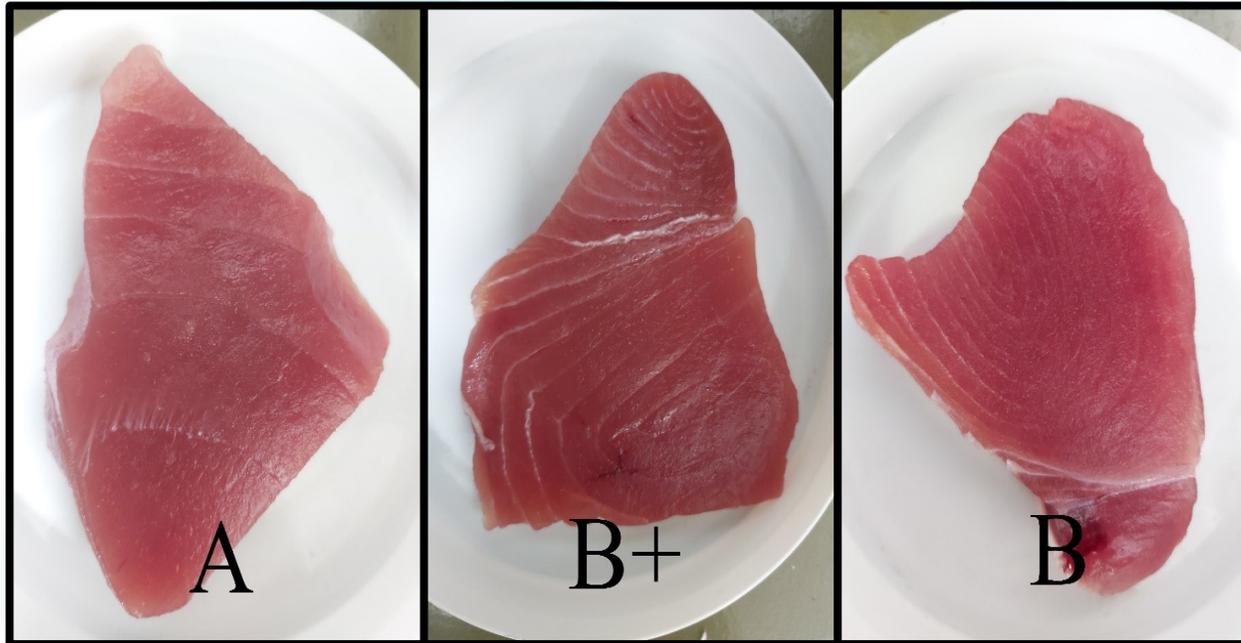
RGB Images of Different Fish Samples

Image Capturing

- 9D Multispectral Image Data Set
  wavelengths – 405,430,505,590,660,740,850,890,950 (nm)
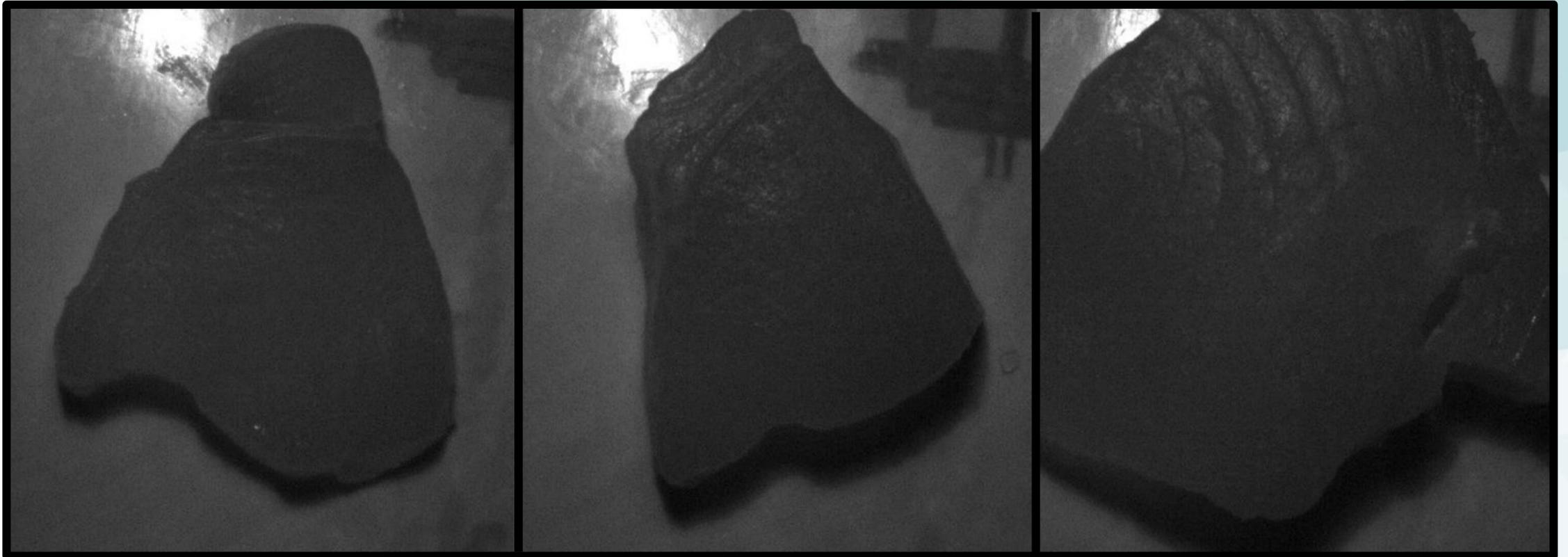
Monochrome HS Images

Image Preprocessing

01. Dark Current Reduction

$$P[\lambda] = S[\lambda] - D$$

where, $P[\lambda]$ is the dark current removed image at wavelength λ, $S[\lambda]$ is the raw image at wavelength λ and D is the dark current image

02. Median Filtering

$$P^*[i,j] = \frac{1}{N} \sum_{k=-w}^{w} \sum_{l=-w}^{w} P[i+k, j+l]$$

where, $P^*[i,j]$ is the updated value of the pixel i,j after the median filtering , $P[i,j]$ is the pixel value of the dark current subtracted image at i,j , w is the suitably chosen window size and N is the number of pixels in the window.

Algorithm

01. Mean Spectral Signature

- The mean variation of reflectance of a samples with respect to wavelengths
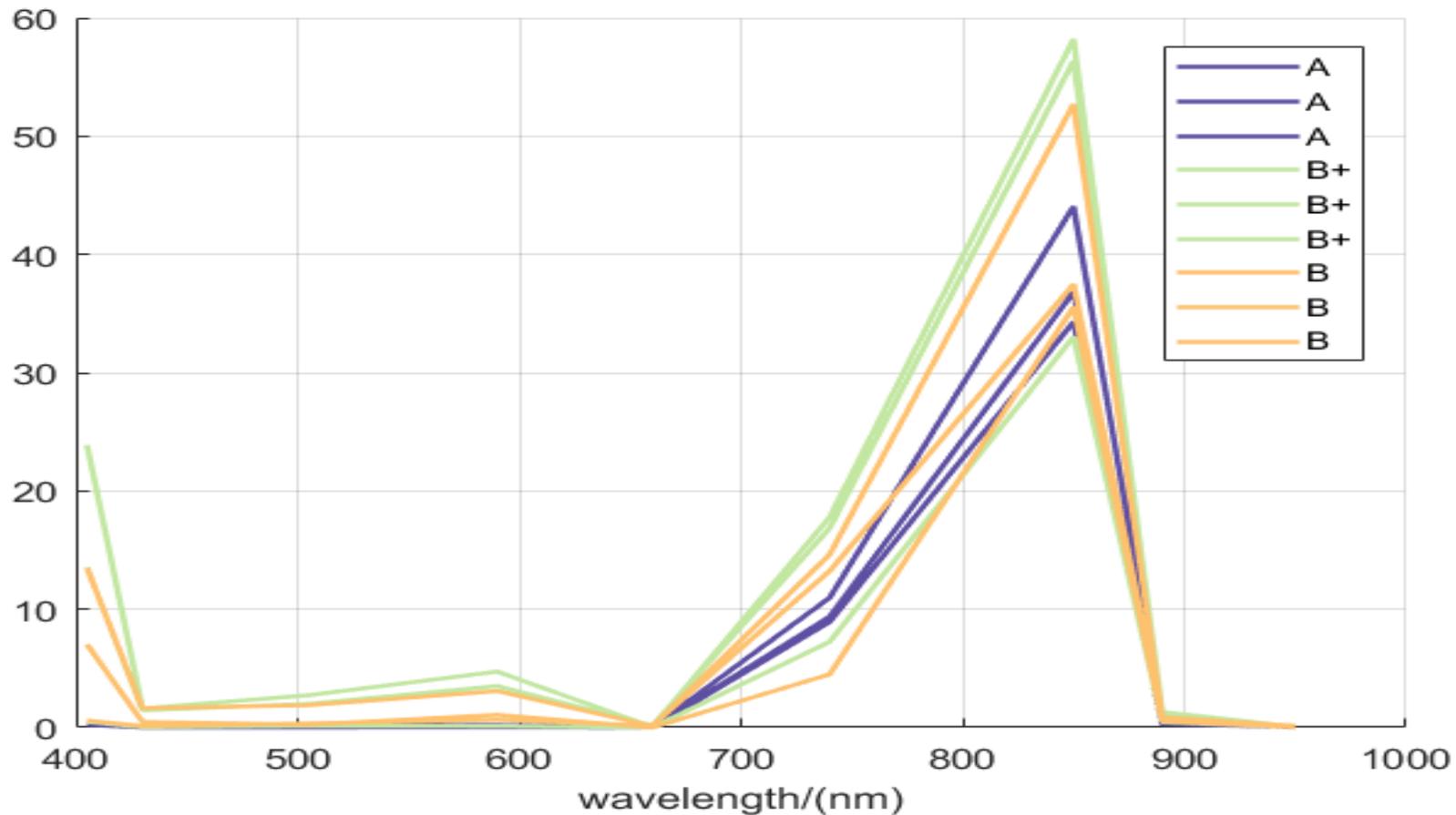
Mean Spectral Signature

Algorithm CONT.

02. Fisher's Discriminant Analysis

This is a dimension reduction/feature extraction method that aligns axis such that projected data are well separated by
 (i) Maximizing the distance between projected class means.
  (ii) Minimizing the within class variances.
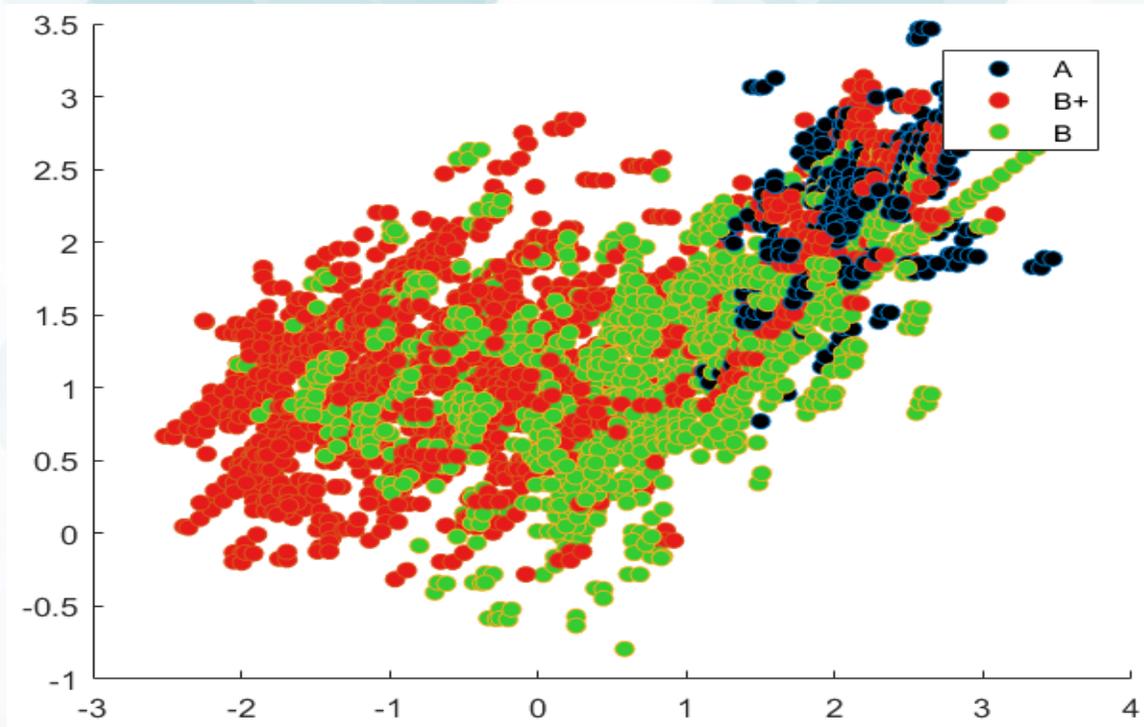
Projected Data Set

Algorithm CONT.

03. Neural Network based classifier

INPUT
9D Images Set
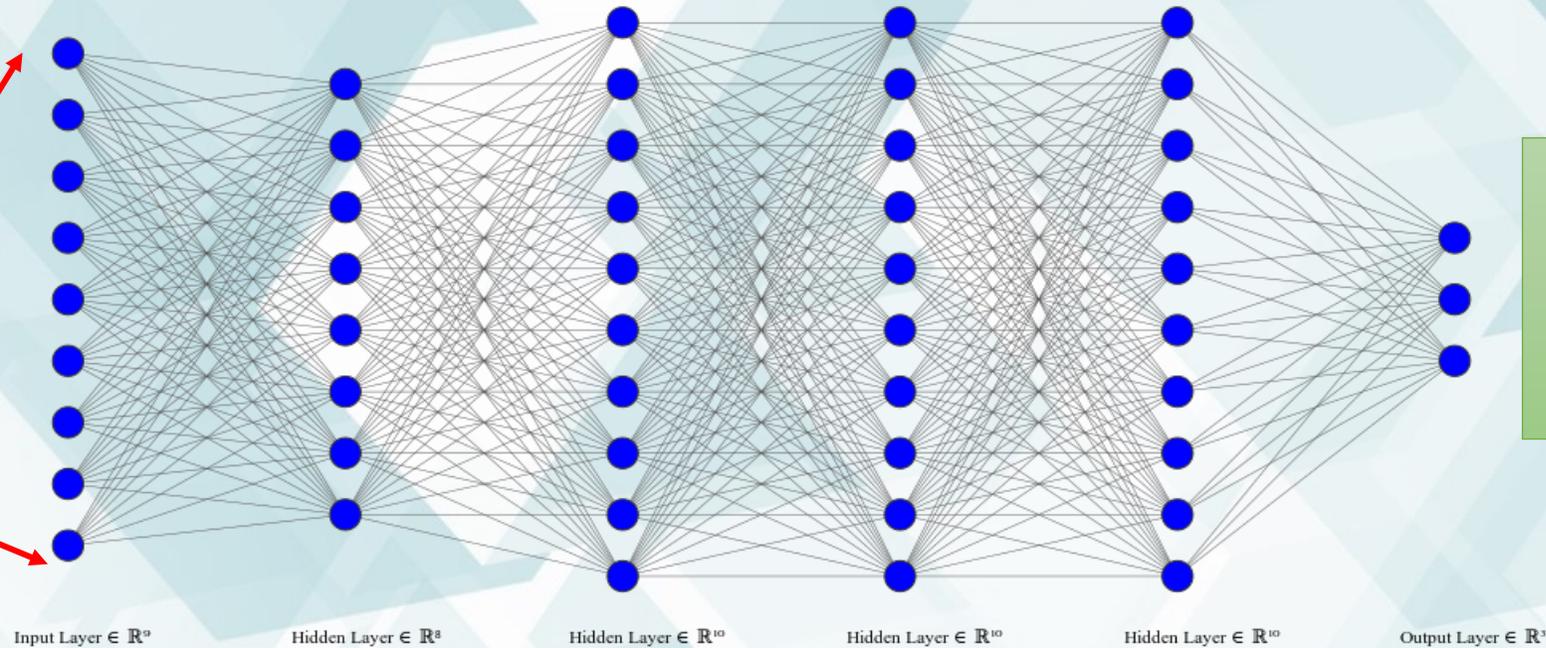
OUTPUT
Grade of the Fish Sample

Input Layer ∈ $\mathbb{R}^9$ Hidden Layer ∈ $\mathbb{R}^8$ Hidden Layer ∈ $\mathbb{R}^{10}$ Hidden Layer ∈ $\mathbb{R}^{10}$ Hidden Layer ∈ $\mathbb{R}^{10}$ Output Layer ∈ $\mathbb{R}^3$

Neural Network

Results

Grade	Precision/%	Recall/%	F1-score/%
A	87	90	88
B+	91	98	88
B	92	95	94
Avg	90	90	90

Conclusion

- The developed MSI setup can be used to implement a system to detect the fish quality.

- To improve the accuracy of the classification results, need to obtain images of several samples.

References

[1]   G. Hyldig and D. M. B. Green-Petersen, "Quality Index Method—An Objective Tool for Determination of Sensory   Quality," *J. Aquat. Food Prod. Technol.*, vol. 13, no. 4, pp. 71–80, Apr. 2005, doi: 10.1300/J030v13n04_06.

[2]   *Hyperspectral Imaging for Food Quality Analysis and Control*. Elsevier, 2010.

[3]   W. G. Chaminda Bandara *et al.*, "Validation of multispectral imaging for the detection of selected adulterants in   turmeric samples," *J. Food Eng.*, vol. 266, p. 109700, Feb. 2020, doi: 10.1016/j.jfoodeng.2019.109700.

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Thank You