

## Fresh Meat Classification on Web Application

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DOI: <https://doi.org/10.30880/eeee.2023.04.02.023>

Received 15 January 2023; Accepted 04 September 2023; Available online 30 October 2023

**Abstract:** Meat is one of the most nutritious foods since it includes carbs, proteins, lipids, vitamins, and minerals. The amount of freshness in meat is a significant component in determining meat quality. Therefore, meat quality should be maintained so that consumers receive high-grade meat. Meat quality is often determined visually by comparing genuine meat with reference photographs of each meat class. This procedure has flaws because it is subjective in nature and takes a long time. As a result, an image- processing-based automated system capable of detecting meat quality is required. In this work, a convolutional neural network approach is used to detect meat freshness. The meat utilised in the work is categorized into two types: fresh and spoiled. The goal of this work is to create an image processing system for meat quality classification by analysing digital pictures. The system's implementation is to obtain equal measurement because different human examiners obtain different results, and to develop an image classifying system by implementing CNN algorithm with image processing technique and to evaluate the performance of the program classifier and prediction of validation data using training run results.

**Keywords:** Image Processing, CNN, Python, Gradio, Web App

### 1. Introduction

Meat and poultry are one of the animal food products that are high in demand all around the world as it is one of the main protein sources. Our food structure has changed dramatically as the economy has developed and people's living standards have improved. Meat consumption has increased and the quality of meat has attracted increasing amount of attention. Many developed countries have meat quality evaluation methods and standards for their respective criteria. As a result, meat quality should be maintained so that consumers receive high quality meat. Other than that meat quality is frequently determined visually by comparing actual meat with reference images of each meat class. As per mentioned in "Statista" website, Malaysians 2021, Malaysians are expected to consume 49.7kg of poultry meat per person in 2021 thus putting Malaysia amongst the world's top consumers of poultry meat for halal meat and goods [1]. By leveraging increasing purchasing power among consumers in other Muslim markets, Malaysia stands to benefit from both local demand and strong export

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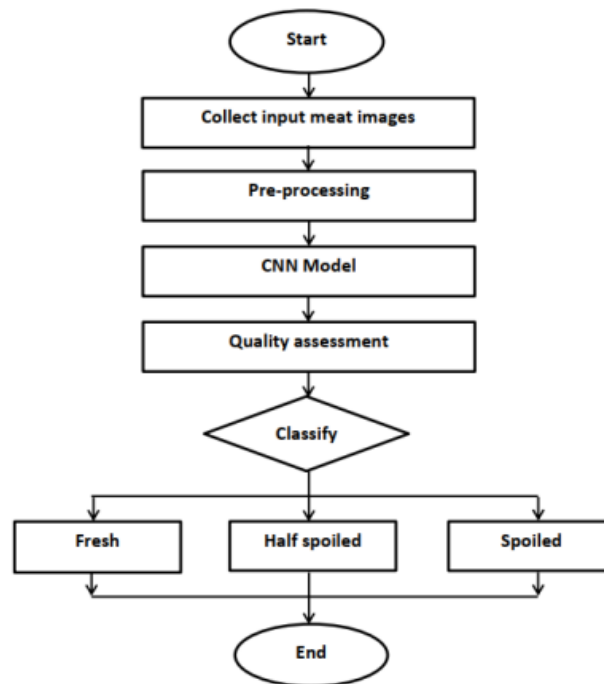
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opportunities. Since the pandemic that storms, more Malaysians work from home that resulting them to have more time to cook and prepare meals at home at the same time increasing the meat demand in the market [2].

## 2. Materials and Methods

Figure 1 is the block diagram of the general working principle of system. The software and libraries needed in conducting this research includes Google Colaboratory, or “Colab” for short which is a product from Google Research and an online notebook that runs in cloud. The libraries that are needed in making the system are Python programming language, Keras, TensorFlow and Gradio.



**Figure 1: General working principle of system**

### 2.1 Data Collection

To obtain data, the researcher requires data images of the object to be studied and made a systematic recording of an idea being investigated. Thus, a dataset from Kaggle website was taken to be used for this work. There were 1078 images of meats could be used for research but 863 are used for training because the other condition of the meats was not good. The images of fresh meat used were obtained from Kaggle which were then extracted using Google Colab. 334 image data were used as training data of fresh meat, 228 for half spoiled meat and 301 image data for spoiled meat.

### 2.2 Data Processing

The training data used 34 meat images, while the test data also used 1078 images of meat images. Then the image acquisition stage was carried out on the dataset. Histogram equalization was chosen for this system because it improves the overall contrast of many photos, particularly when the image's useable data is represented by near contrast values. Histograms simply visualise the frequency of pixel intensity in an image by utilising a graph that shows the frequency of the image. A histogram simply illustrates the frequency of pixel intensity in a picture. Furthermore, the extraction of shape and texture features was carried out in the shape pattern recognition process using two combinations of parameters, namely metric and eccentricity, which aimed to extract metric and eccentricity values.

After that, the classification continued with the CNN method which aimed to classify objects based on learning data that is the closest distance or has the most similarities with the object. To enhance the recognition performance of low-quality images, a CNN-based approach is applied. Therefore, a new CNN model is built and trained the model suitable with the classifying system.

### 2.3 Convolutional Neural Network (CNN)

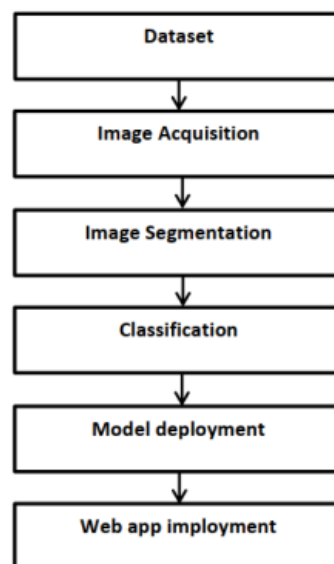
The CNN feature extraction model aims to minimise the quantity of features in a dataset. It generates new features that compile an initial set of features' existing features into a single new feature [4]. Different bit-planes contribute differently to the accuracy of classifying meat photos. The higher the bit-plane, the more properties of the image structure it theoretically carries. The lower bit-planes contain a high degree of content unpredictability and convey relatively little image energy. We contrast the original image feature on CNN classifier with the image feature from one to eight bitplane slicing [5].

### 2.4 Web App Development

The trained model is deployed to the web using Gradio since it is easy to use, has a user-friendly interface, can run on a local server, and can also be published as a temporary external URL for public use. The input section and output section compensate the UI. Users can drag and drop, browse, or capture a screenshot from a live webcam feed at the input section. The CNN model is given this image as input. In the output area, the CNN model's output is displayed. The website asks Gradio to response, and the server then stores the images. The model is then asked by the Gradio server to determine the proper class.

### 2.5 Testing Flow

In this work, there are several stages in testing to get the results of the accuracy of the image quality of fresh meat.



**Figure 2: Flow diagram of testing flow**

Figure 2 is a flow diagram in the tests that were carried out. The dataset was divided into training and test data for testing. The image acquisition step outmedmetric and eccentricity, with the goal of obtaining metric and eccentricity values by using edge detection. The role of segmentation in this case is to make the representation more relevant and easier to analyse and divide the image into different regions. Thresholding segmentation, for example, achieves the goal based on the discontinuities of

grayscale or colour properties by the boundaries of the regions. Following that, the CNN approach was used to classify images based on learning data with the closest distance or the most similarities to the item based on the meat's colour and texture.

### 3. Results and Discussion

The results that shown are the data collections, data training, pre-processing, image classification and web app development Python, Keras TensorFlow and Gradio library in Google Colab.

#### 3.1 Image Data Training

In order to solve the problem of image classification, our data needs to adopt a specific format. The image data used are images of fresh and spoiled meat obtained from Kaggle. The datasets are then saved in Google Drive under Dataset file that was converted into .zip format. Google Drive was mounted into Google Colab to download the datasets directly for user to use them on Google Colab notebook.

#### 3.2 Install and Import Libraries

The program includes free access to computer resources without requiring new users to download and install their libraries to the personal computer because it does not require any setup to use. Before starting to build the code, use the 'import' command to add extra libraries and packages that are not included with Colab by default. The libraries and packages utilised in this notebook include "NumPy," "matplotlib," which is a compressive library for Python graphics, "TensorFlow," which is used for data automation, model retraining, and performance monitoring.

#### 3.3 Pre-processing Data

This stage was done by changing the colour image into a grayscale image. This stage was used to facilitate the next image process, namely the segmentation process and if a large number of images in the training set. In the segmentation process using thresholding, the process was based on differences in the gray level of the image and the result is a grayscale image. "glob" modules were use in retrieving the images of spoiled and fresh images based on the specified pathname and pattern. It is also a tool to help with folders management to determine the specific path of folders or files in the filesystem.

#### 3.4 Histogram

For histogram image segmentation, the image will be scanned in a single pass, and a running total of the number of pixels identified at each intensity level will be retained. This is then utilized to create an appropriate histogram.

#### 3.5 Image Classification using CNN

The instruction that uses pyplot that works to plot the framework merely modules and libraries. This is continued by using plt.figure function that will create either a new figure or activate existing figure. The CNN will learn from the trained images in pre-processing and perform image classification. Figure 3 shows the instructions used in classifying the images.

Figure 4 shows the meats qualities were classified successfully by displaying few meats that were already named after their respective qualities. These showed that the training process by using the datasets was successfully done.

```
[11] class_names = train_ds.class_names
print(class_names)

['Fresh', 'Half Spoiled', 'Spoiled']

[12] import matplotlib.pyplot as plt

plt.figure(figsize=(12, 12))
for images, labels in train_ds.take(1):
    for i in range(12):
        ax = plt.subplot(3, 4, i + 1)
        plt.imshow(images[i].numpy().astype("uint8"))
        plt.title(class_names[labels[i]])
        plt.axis("off")
```

**Figure 3: Finding class names in file path and plotting framework**



**Figure 4: Image classification output**

### 3.6 Web Application

The Gradio Python module was set up in order to move on to the subsequent steps. Together with the Tensorflow package, a pre-trained Keras image classification model was employed. The prediction should then be returned by a function that accepts the user input, which in this example is an image. A drag-and-drop image component is used as the input component in this instance. The "gradio.inputs.Image" class, which builds the component and makes sure of the pre-processing to convert it into a NumPy array, can be used to create this input. In order to automatically pre-process the source image to be 100 pixels by 100 pixels, this will instantiate the class with that exact argument. Lastly, the resulting UI can be checked in your browser by clicking the generated link.

Figure 5 to 7 show the Web App Application to classify and predict the uploaded image as Fresh Meat, Half Spoiled Meat and Spoiled meat respectively. This can be done by easily drop or upload images from the local computer and click "submit" to show output of the model classification.

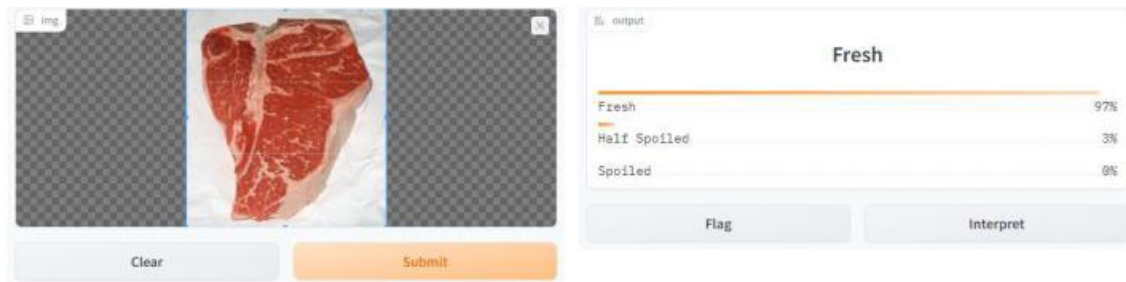


Figure 5: Web Application classified and predicted fresh meat

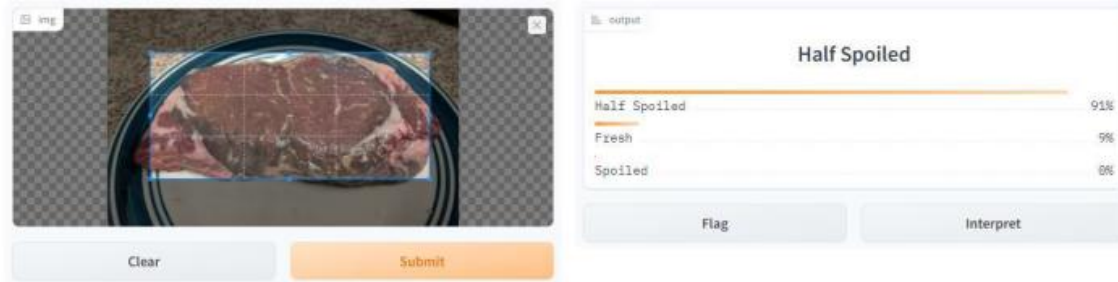


Figure 6: Web Application classified and predicted half spoiled meat

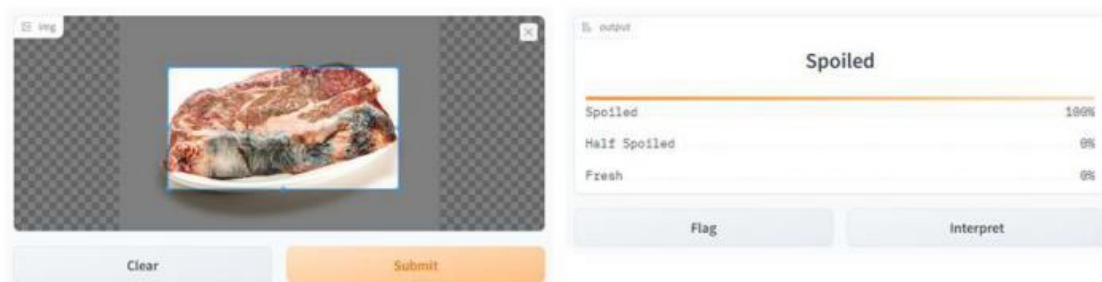


Figure 7: Web Application classified and predicted spoiled meat

### 3.7 Accuracy

To ensure that the training data does not encounter any issues, it is essential to assess the classification system. A vector set and the expected response from the web classifier are used in the verification of the recognition quality. Table 1 shows the average accuracy obtained for fresh meat is 80%. Whilst, the half spoiled and spoiled meat are 80% and 90%, respectively. A total of 10 accuracy test were observed to get the average value of the three classes. The average accuracy of the meat freshness classification system is 83.33%.

Table 1: Accuracy according to meat type

Meat Type	Test No.										Accuracy (%)
	1	2	3	4	5	6	7	8	9	10	
Fresh	/	/	/	X	/	/	X	/	X	/	80
Half spoiled	X	/	/	/	/	/	/	/	X	/	80
Spoiled	/	/	X	X	/	/	/	/	/	/	90

## 4. Conclusion

In conclusion, functionality of meat freshness classification system is a challenging issue especially in if the input images do not have distinct features that can be read by the system. The CNN algorithm to identify the quality of meat is done by using Python to create a classifying system that is able to

classify the quality of meat images based on their freshness. Other than that, is building an interactive tool for user to classify meat quality by connecting a web app to a Colab notebook which Gradio is implemented along with the program. The evaluation of the performance of the program classifier and prediction of validation data by using outcomes from the training runs is analysed based on the output that the web app shown as the predicted results. Based on the results of the research on the quality classification of meat freshness by using the CNN, it can be concluded that this method can be applied in the quality classification of meat freshness with an accuracy of 80%.

### **Acknowledgement**

The authors would also like to thank the Faculty of Electrical and Electronic Engineering, Universiti Tun Hussein Onn Malaysia for its support.

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