Nigeria Indigenous Food Image Classification Using MobileNetV2:

Abstract:

In our research we tried to classify African food using MobileNetV2. The MobileNetV2 architecture is based on an inverted residual structure where the input and output of the residual block are thin bottleneck layers opposite to traditional residual models which use expanded representations in the input an MobileNetV2 uses lightweight depthwise convolutions to filter features in the intermediate expansion layer. The aim of this study is to implement a Nigeria Indigenous Food Image Recognition System. In this study, a dataset utilizes a dataset sourced from Kaggle containing images of different Nigerian foods, including Jollof Rice, Pounded Yam, Egusi Soup, Suya, and others, the images were pre-processed using Pytorch framework, then, the features were extracted and classified using the MobileNetV2 algorithm.A 80% level of accuracy of correct recognition was achieved with the model.Based on our findings, MobileNetV2 has achieved higher level of accuracy.

Introduction:

Classification of foods according to their images becomes a popular research task for various reasons such as food image retrieval and image based self-dietary assessment. However,Food is anything that can be eaten and would supply the desired nutrients meant for growth, development and good living in both plants and animals. Food is an essential part of human life and hence humans have found creative, easy and conducive ways to satisfy their eating urge by manipulating available plant and animal produce for meat, grains etc. to their satisfaction to get desired nature, quality and quantity of food. (Nelson,2000).Owing to the rapid rate of civilization, many indigenous foods from different cultures in Nigeria are going into extinction with the advent of modern-day fast foods, therefore the need arises to preserve the knowledge of these meals and make their recipes available for the present age and years to come using artificial neural networks to correctly recognize them.The aim of this paper is to implement a Nigerian Indigenous Food Image classification System.The objectives of this work include:

• Develop an image classification model capable of accurately identifying various Nigerian food dishes.

• Utilize deep learning techniques, specifically convolutional neural networks (CNNs), implemented using PyTorch.

• Train the model on a dataset consisting of images of Nigerian foods sourced from Kaggle.

Evaluate the model's performance using appropriate metrics and techniques.

Related Work:

In the related paper that introduced the dataset (Food 101), Bossard et al. employed a weakly supervised mining method that relied on Random Forests (RFs) to mine discriminative regions in images, which yielded an accuracy of 50.76%, outperforming all other alternative classification methods at the time, except for the CNN approach, which as implemented by the paper achieved 56.40% accuracy on the same dataset. A subsequent study on food image classification focused solely on the use of CNNs constructed a five-layer CNN to recognize a subset of ImageNet data which consisted of ten food classes. Lu's approach showcases the higher potential of CNN versus a bag -of-features (BoF) model, with the CNN model outperforming BoF by 74% to 56% accuracy. Additional data augmentation techniques were applied to bring up accuracy to 90%, which far outpaces the best BoF performance. However, given the much reduced number of classes, the paper's model performance cannot be directly mapped to model performance on the Food-101 dataset.More recently, Liu et al. implemented DeepFood a CNN-based approach inspired by LeNet-5,AlexNet ,and GoogleNet, employing Inception modules to increase the overall depth of the network structure. DeepFood achieved 77.4% top-1 accuracy on the Food-101 dataset after 300,000 epoch.

Research Methodology:

Data Collection:

The dataset used in this project consists of images of various Nigerian food dishes collected from Kaggle. The dataset contains a numerous images and classes, including:

Jollof Rice

Pounded Yam

Egusi Soup

Suya

Other Nigerian food dishes

The images are organized into a directory structure where each class has its folder

containing the respective images.Images were normalized and resized appropriately, either to 128x128 or 256x256 in the initial model implementations, or to model specification when using MobileNetV2. Image data was augmented through rotation, shifting, and horizontal flipping to avoid overfitting.

Exploratory Data Analysis:

Our approach is focused on food image classification on the Nigeria indigenous dataset from kaggel. The initial step we explored is Exploratory Data Analysis (EDA), aimed at gaining valuable insights from the images. EDA entails the examination and interpretation of information and relevant data to draw conclusions regarding images.Therefore, we visualized the most common food images to assess data quality, image size and aspect ratio, verify the size and shape of annotated bounding boxes and class imbalance.

Model:

In our research paper, we explored the MobileNetV2 which is lightweight deep neural network architecture designed for efficient mobile and edge device applications. It balances model size and accuracy, making it ideal for resource-constrained environments. Moreover, MobileNetV2 is also utilized for tasks like image classification and object detection, providing reliable performance with reduced computational overhead.

Results and Discussion:

Our research shows the performance of MobileNetV2 model on indigenous Nigeria food image classification achieved the best performance performance with an prediction score of 80%. However,we have not explored some others image classification models such as AlexNet, VGGNet,ResNet etc to compare their performance on the Nigeria food image classification.

Conclusion and Recommendation:

In this research study, we proposed a framework for Indigenous Nigeria food image classification. An accuracy of 80% was achieved on the second iteration which was an improvement on the 66% to 80% which was recorded at every iterations respectively after 5 epoch. The results obtained revealed that the framework is capable of producing state-of the-art results due to a high level of accuracy of the classifications obtained

given the relatively limited training dataset used.

Further work should dig further on food image classification according to Nigeria regions such as North, East, south and west types of foods.

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