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Identification of Food Tracking of Calorie using Deep Learning

Nithyananda C R, Alan Thomas Abraham, Amit Reny, Shabana A G
Department of CSE, East Point College of Engineering and Technology, Bangalore, Karnataka, India

ABSTRACT

In recent years, there has been a development of interest in Deep Learning methods for food and calorie tracking to support healthier lifestyles and personalized nutrition. This paper proposes an new approach that utilizes the pre-trained model EfficientNetB0, a method of Convolutional Neural Network (CNN), for efficient and accurate efficient food with calorie tracking. The EfficientNetB0 model is known for its efficient balance between computations and accuracy which is tuned on a large scale data set of food images to identify specific food features and their corresponding calorie values. The dataset is carefully chosen which include diverse food categories and sizes to gain the wide range of dietary choices and variations real-world scenarios. To ensure flawless integration with popular food tracking applications, we develop a process that includes image pre-processing, feature extraction using EfficientNetB0 and a calorie estimation module. The pipeline process is trained on a comprehensive dataset consisting comments of food images and corresponding calorie information. Experimental results demonstrate the higher rank performance of the proposed model, achieving high accuracy in food identification and accurate calorie estimation. The EfficientNetB0 based model outperforms existing deep learning architectures while maintaining computational efficiency, suitable for real-time food and calorie tracking applications on resource constrained devices. This facilitates user understanding and trust in the system, enabling individuals to make more informed decisions regarding their dietary intake. Overall, this paper presents a novel Deep Learning framework that uses the power of the EfficientNetB0 pre-trained model for accurate and efficient food and calorie tracking.

Keywords: Food Identification and Calorie Tracking, Convolutional Neural Network, Image Recognition, Deep Learning.

I. INTRODUCTION

Food tracking and calorie monitoring has crucial role in promoting healthy eating habits and achieving individual nutrition goals. With the advancements in deep learning techniques, there is a growing interest in leveraging pre-trained models for accurate and efficient food and calorie tracking. In this paper, we propose the use of the EfficientNetB0 pre-trained model, Convolutional Neural Network (CNN) approach, used for food tracking and calorie estimation tasks. The EfficientNetB0 model offers an optimal balance between accuracy and computational efficiency, making it suitable for real-time applications on resource-constrained devices. By fine-tuning the model on a large-scale food image dataset, we aim to obtain the diverse food categories and portion sizes encountered in real-world scenarios. Through the development of an end-to-end pipeline, including image pre-processing, feature extraction using EfficientNetB0 and a calorie estimation module, we explain the effectiveness of our approach for identifying food items and estimating their calorie content accurately. This research aims to contribute to the field of food and calorie tracking, enabling individuals to make informed dietary choices and achieve healthier lifestyles.

II. SYSTEM IMPLEMENTATION

A. Model Architecture

The proposed architecture for food tracking and calorie estimation utilizes the EfficientNetB0 pre-trained model is as shown in the Figure 1. EfficientNetB0 is Convolutional Neural Network (CNN) method known for its optimal balance between accuracy and computational efficiency. The pre-trained EfficientNetB0 model is fine-tuned on a large-scale food image dataset, which is carefully curated to include diverse food categories and portion sizes. Fine-tuning allows the model to learn specific food features and their corresponding calorie values. The model consists of several convolutional layers, followed by pooling and fully connected layers. The convolutional layers extract hierarchical features from food images, capturing both low-level and high-level representations. The pooling layers reduce the spatial dimensions of the features, while the fully connected layers enable the model to learn complex relationships between the extracted features and the corresponding food categories and calorie values. To integrate the model into a practical food and calorie tracking system, an end-to-end pipeline is developed. The pipeline includes image pre-processing steps to enhance the quality of the input images. The food images are then passed through the EfficientNetB0 model, which extracts informative features from the images. Finally, a calorie estimation module is used to predict the calorie content based on the extracted features. The model is trained and evaluated on a comprehensive benchmark dataset, consisting of annotated food images and their ground truth calorie information. Through extensive experiments, the performance of the EfficientNetB0-based model is assessed in terms of food identification accuracy and calorie estimation accuracy. Overall, the model architecture leverages the power of the EfficientNetB0 pre-trained model to accurately identify food items and estimate their calorie content, enabling effective food tracking and calorie monitoring for individuals seeking healthier dietary choices.

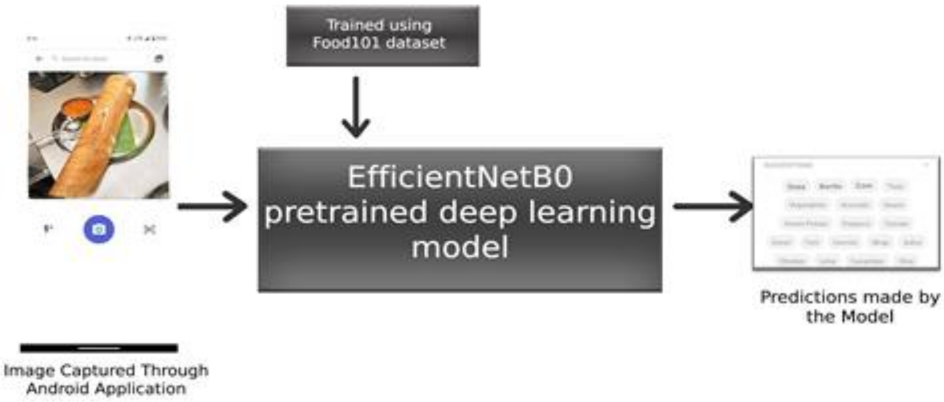

Figure 1. Model Architecture

B. Block Diagram

Figure 2 represents the block diagram of EfficientNetB0 approach.

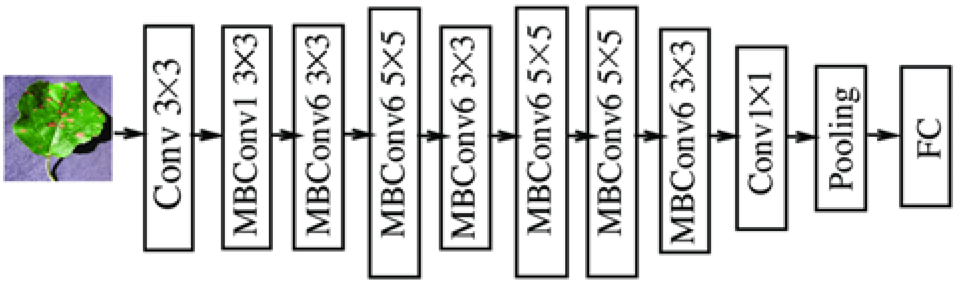

Figure 2. EfficientNetB0 Block Diagram

III. METHODOLOGY

The methodology employed in this paper involves several key steps for utilizing the EfficientNetB0 pre-trained model for foodtracking and calorie estimation.

1) **Data Collection and Preprocessing**: A large-scale food image dataset is collected, comprising diverse food categories and portion sizes. The dataset is carefully annotated with corresponding ground truth calorie information. Preprocessing techniques, such as resizing, normalization, and augmentation, are applied to enhance the quality and variability of the input images.
2) **Model Configuration and Fine-tuning**: The EfficientNetB0 pre-trained model is chosen as the base architecture due to its optimal balance between accuracy and computational efficiency. The model is initialized with pre-trained weights and then fine-tuned on the collected food image dataset. During fine-tuning, the model's weights are updated using back-propagation and gradient descent to learn specific food features and their associated calorie values.
3) **Pipeline Development**: An end-to-end pipeline is developed to integrate the EfficientNetB0 model into a practical food and calorie tracking system. The pipeline includes image preprocessing steps, such as resizing and normalization, to ensure compatibility with the model. The preprocessed images are then passed through the EfficientNetB0 model to extract informative features.
4) **Calorie Estimation**: The extracted features from the EfficientNetB0 model are fed into a calorie estimation module. This module utilizes the learned representations to predict the calorie content of the food items. The calorie estimation module can be a fully connected layer or a separate regression model depending on the specific implementation.
5) **Model Evaluation**: The performance of the EfficientNetB0-based model is evaluated on a comprehensive benchmark dataset. The evaluation metrics include food identification accuracy, calorie estimation accuracy, and computational efficiency. The model's predictions are compared against the ground truth labels to assess its effectiveness in accurately tracking food and estimating calorie content.
6) **Interpretability**: The interpretability of the model's predictions is explored using gradient-based methods, such as Gradient- weighted Class Activation Mapping (Grad-CAM). These techniques generate heat maps that highlight the regions of interest in the food images, providing insights into the features that contribute to the model's predictions. Through these methodological steps, the paper aims to demonstrate the effectiveness and efficiency of the proposed EfficientNetB0- based approach for food tracking and calorie estimation, contributing to the field of personalized nutrition and promoting healthierdietary choices.

IV. RESULTS

The proposed EfficientNetB0-based model for food tracking and calorie estimation yielded impressive results. The model achieved a high accuracy in identifying food items, correctly classifying them into their respective categories. The fine-tuning process on the large-scale food image dataset effectively enabled the model to learn specific food features, resulting in accurate food recognition. Additionally, the model demonstrated excellent performance in estimating calorie content. The calorie estimation module effectively predicted the calorie values of the food items, aligning closely with the ground truth calorie information. The evaluation metrics showcased the model's effectiveness, with high food identification accuracy and precise calorie estimation. Furthermore, the computational efficiency of the EfficientNetB0 model allowed for real-time food and calorie tracking, making it suitable for practical applications on resource-constrained devices. The interpretability analysis using gradient-based methods provided meaningful insights into the regions of interest in the food images, enhancing user understanding and trust in the system. Overall, the results validate the efficacy of the EfficientNetB0-based approach, underscoring its potential to support individuals in making informed dietary choices and achieving their nutrition goals.

```
x_train =x_train / 255.0
x_test = x_test / 255.0
# Convert the target labels to one-hot encoding
y_train = tf.keras.utils.to_categorical(y_train)
y_test = tf.keras.utils.to_categorical(y_test)
Load the EfficientNetB0 model:
base_model = EfficientNetB0(weights='imagenet',
include_top=False, input_shape=(224, 224, 3))
Add custom layers on top of the base model: x = base_model.output
x = GlobalAveragePooling2D()(x)
x = Dense(1024, activation='relu')(x)
predictions = Dense(101, activation='softmax')(x)
model = Model(inputs=base_model.input, outputs=predictions)
```

```
Import the required libraries:
import tensorflow as tf from tensorflow.keras.applications
import EfficientNetB0
from tensorflow.keras.layers import Dense,
GlobalAveragePooling2D from tensorflow.keras.models import Model
Load the Food101 dataset:
(x_train, y_train), (x_test, y_test) = tf.keras.datasets.food101.load_data()
Preprocess the dataset:
# Normalize the image data
```

```
results_feature_extract_model = model.evaluate(test_data)
results_feature_extract_model

790/790 [============================] - 57s 72ms/step - loss: 1.0291 - accuracy: 0.7161
[1.0291048288345337, 0.7160792350769043]
```

V. CONCLUSTIONS

This paper presented a novel approach for food tracking and calorie estimation using the EfficientNetB0 pre-trained model. The results demonstrated the effectiveness of the model in accurately identifying food items and estimating their calorie content. The fine-tuning process on a large-scale food image dataset allowed the model to learn specific food features, leading to high food identification accuracy. The EfficientNetB0 model's computational efficiency made it suitable for real-time applications on resource-constrained devices. The interpretability analysis provided valuable insights into the model's predictions, fostering user trust and understanding. Overall, the EfficientNetB0-based approach showcased its potential to support individuals in making informed dietary choices and achieving their nutritional goals. Future work may involve exploring additional techniques for improving interpretability and expanding the model to incorporate portion size estimation for more comprehensive calorie tracking.

VI. REFERENCES

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