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Estimating Indian Food Calorie with Convolution Neural Networks

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ABSTRACT:

Accurate estimation of food calories plays a crucial role in promoting healthy eating habits and managing diet-related health conditions. Indian cuisine presents unique challenges in this domain due to its rich diversity, complex food compositions, and varied preparation methods. In this study, we propose a deep learning-based approach for automatic calorie estimation of Indian food using Convolutional Neural Networks (CNNs). Our system leverages a large dataset of labeled Indian food images, annotated with corresponding calorie information. We employ CNN architectures to classify food items and estimate portion sizes, followed by a mapping to nutritional databases to predict caloric values. To address intra-class variations and occlusions common in Indian dishes, we incorporate techniques such as image augmentation, transfer learning, and ensemble modeling. Experimental results demonstrate promising accuracy in calorie estimation across a wide range of Indian foods. This work has the potential to aid in the development of mobile health applications for personalized dietary monitoring and nutrition tracking in diverse cultural settings.

1. Introduction

With the rising prevalence of diet-related health conditions such as obesity, diabetes, and cardiovascular diseases, the need for accurate and accessible dietary monitoring tools has become increasingly important. One of the critical components in such tools is the ability to estimate the caloric content of consumed food, which plays a key role in maintaining energy balance and overall health. However, manual tracking of calories is often tedious, error-prone, and time-consuming, especially when dealing with complex or culturally diverse cuisines.

Indian cuisine, known for its vast diversity and richness, presents significant challenges for automated calorie estimation. Unlike standardized packaged foods, traditional Indian meals often consist of mixed dishes with varying ingredients, portion sizes, and cooking methods. The visual appearance of such dishes can differ significantly depending on regional styles, personal preferences, and presentation, making conventional image-based classification and calorie estimation difficult.

Recent advancements in computer vision and deep learning, particularly Convolutional Neural Networks (CNNs), have shown promising results in food recognition and nutrient estimation. CNNs are capable of learning hierarchical representations of images and have been successfully applied in tasks such as object detection, classification, and segmentation. In the context of food analysis, CNNs can be trained to recognize food items, estimate portion sizes, and infer nutritional values from images, thereby providing an end-to-end solution for calorie estimation.

This study explores the application of CNNs to estimate the caloric content of Indian food from images. By leveraging a curated dataset of Indian food images labeled with nutritional information, we develop and evaluate deep learning models capable of recognizing food types and predicting calorie values. Our approach includes techniques such as transfer learning from pre-trained CNN models, data augmentation to increase robustness, and post-processing methods to improve accuracy in portion estimation. We also address the challenges unique to Indian food, including visual similarity among dishes, non-standard portion sizes, and mixed food items.

The proposed system aims to support applications in mobile health (mHealth), diet tracking, and personalized nutrition, making it easier for individuals to monitor their food intake and make informed dietary choices. Through this work, we contribute to the growing field of AI-driven nutrition analysis, with a particular focus on cultural adaptability and real-world applicability.

Despite the growing availability of diet-tracking applications, most current systems rely heavily on manual user input or barcode scanning, which is impractical for home-cooked or restaurant-prepared Indian meals. These methods often fail to capture the real caloric content due to missing ingredient-level details and inaccurate portion size estimations. Furthermore, generic food recognition models trained on Western datasets are typically ineffective when applied to Indian cuisine, which includes a vast array of regional dishes such as biryani, dosa, paneer curries, dal, and various types of bread like roti and naan — many of which lack standardized appearances or consistent compositions.

The use of image-based calorie estimation provides a more user-friendly alternative by allowing users to simply photograph their meals. However, accurate calorie estimation from images involves multiple complex tasks: detecting the type of food, estimating portion size, and mapping it to nutritional information. Convolutional Neural Networks (CNNs) are well-suited for this challenge due to their ability to learn spatial hierarchies and recognize patterns in visual data.

In this study, we explore how CNNs can be effectively trained to recognize Indian food items and estimate their caloric values from a single image. Our focus is on creating a scalable, adaptable, and culturally-aware solution that can serve both healthcare professionals and end-users. To achieve this, we build a specialized dataset of Indian food images with calorie annotations, and evaluate multiple CNN architectures including MobileNet, ResNet, and EfficientNet for their performance on this task.

The ultimate goal of this research is to develop a robust and efficient system that can assist individuals in making informed decisions about their dietary habits. By providing automated classification of food images and extracting relevant textual information, the project aims to empower individuals to adopt healthier eating patterns without the need for rigid nutritional plans. Furthermore, the findings of this research can have significant implications in various domains, including healthcare, nutrition science, and dietary counseling. By leveraging the power of machine learning and deep learning techniques, the project contributes to the advancement of food classification and dietary analysis, ultimately promoting better health and well-being for individuals across diverse populations.

2. Review of literature

[1]. Szegedy, C., Vanhoucke, V., Ioffe, S., Shlens, J., & Wojna, Z. (2016). Rethinking the inception architecture for computer vision. In Proceedings of the IEEE conference on computer vision and pattern recognition (pp. 2818-2826) They have provided several design principles to scale up convolutional networks and studied them in the context of the Inception architecture. This guidance can lead to high performance vision networks that have a relatively modest computation cost compared to simpler, more monolithic architectures. The combination of lower parameter count and additional regularization with batch- normalized auxiliary classifiers and label-smoothing allows for training high quality networks on relatively modest sized training sets.

[2]. J. D. A. Berg and L. Fei-Fei, “Large scale visual recognition challenge 2010,” [Online accessed 29-Jan- 2018]. Our final contribution is a hashing scheme for bilinear similarity on probability distributions that is shown to provide efficient (sublinear) retrieval in our setting, and may be useful in a wide range of applications. Using our technique, one query against a database of 600K images takes only 3 milliseconds with an accuracy close to 90% of linear scan and the computational cost 0.001 times that of linear scan. This completes an end-to-end system for very large-scale hierarchical retrieval that has inherent parallelization, linear time training, sublinear time retrieval, and better accuracy and scalability than the state of the art.

[3]. Mohammed A. Subhi and Sawal Md. Ali. “A Deep Convolutional Neural Network for Food Detection and Recognition” (2019) In this paper, we have implemented a basic CNN approach to detect and recognize food items We have presented a new dataset for local Malaysian food which contains food categories with (5800) images. Two datasets were used for performance evaluation of our proposed approach, Food-101 were utilized for food/non-food classification and our proposed. local Malaysian food dataset, which was used for the categorization of food items. Additionally, we have implemented very deep convolutional networks (24 weight layers) for food image classification. Large kernel size at the beginning of the layers ensures that shape features are maintained in the learning process. It was shown that it is beneficial for classification accuracy to have this depth. The results confirm the significance of network depth in training visual representations.

[4]. O. Russakovsky, J. Deng, H. Su, J. Krause, S. Satheesh,S. Ma, Z.Huang, A. Karpathy, A. Khosla, M. Bernstein “ImageNet Large Scale Visual Recognition Challenge” (2019) In this paper we described the large-scale data collection process of ILSVRC, provided a summary of the most successful algorithms on this data, and analyzed the success and failure modes of these algorithms.

[5]. Lukas Bossard and Matthieu Guillaumin and Luc Van Gool “Food Calorie Measurement Using Deep Learning Neural Network” (2014) Diabetes and cardiovascular diseases. In 2014, about 13% of the world's adult population (11% of men and 15% of women) were obese. Accurate estimation of dietary intake is important for assessing the effectiveness of weight loss interventions. In order to reduce bias and improve the accuracy of self-report, we proposed new algorithms to analyze the food image captured by mobile devices (e.g., smartphone). The key technique innovation in this paper is the deep learning-based food image recognition algorithms. Our proposed algorithms are based on Convolutional Neural Network (CNN). Our experimental results on two challenging data sets using our proposed approach exceed the results from all existing approaches. In the future, we learn to improve performance of the algorithms and integrate our system into a real-world mobile devices and cloud computing-based system to enhance the accuracy of current measurements of dietary caloric intake.

[6]. Kaiming He, XiangyuZhang, Shaoqing Ren, Jian Sun “Deep Residual Learning for Image Recognition” (2015) Above method has good generalization performance on other recognition tasks. Table 7 and 8 show the object detection baseline results on PASCAL VOC 2007 and 2012 [5] and COCO [26]. We adopt Faster R-CNN [32] as the detection method. Here we are interestedin the of replacing VGG-16 [40] with ResNet-101.

[7]. Gözde ÖZSERT YİĞİT and Buse MelisÖZYILDIRIM “Comparison of Convolutional Neural Network Models for Food Image Classification” (2018) In this study, the development of a pre-trained structure for food recognition was aimed. To achieve this aim, three different models were implemented, and their performances were compared with that of popular pre-trained models Alex-Net and Caffe-Net. The transfer learning technique was utilized to be able to use these pre-trained models for our problem. Three similar structures were proposed for analyzing the effectiveness of layers separately. While the first structure includes local response normalization layers as in Alex-Net and Caffe-Net, the third structure is the same as the first structure except local response normalization.

[8] Simon Mezgec, Barbara Korousic Seljak "Nutri Net: A Deep Learning Food and Drink Image-Recognition System for Dietary Assessment" (2017) In this paper, they have introduced an intelligent cloud broker for EHSH, supporting different food categories of Single Food Object, Multiple Food Object and Mixed Food Object. We have further introduced a ingredient testing approach for the mixed food category.

The problem of automatic food calorie estimation has been an active area of research at the intersection of computer vision, machine learning, and nutritional science. Early approaches primarily relied on manual data entry or barcode scanning, which provided structured but limited information, mostly applicable to packaged foods. These methods fail to address the complexities involved in estimating calories for freshly cooked meals, particularly in diverse cuisines like Indian food.

Recent advancements have focused on image-based food recognition, driven by the success of deep learning models, especially Convolutional Neural Networks (CNNs). CNNs have proven effective in image classification tasks due to their ability to extract high-level visual features. Systems like **IM2Calories** by Google Research attempted to estimate calorie intake from food images using deep learning, incorporating both food classification and volume estimation. However, their applicability is limited to Western foods and standardized meal types.

Several works have proposed CNN-based models for food classification. For instance, Kawano and Yanai (2015) used a CNN model for food recognition on the UEC Food-100 dataset, achieving significant improvements in classification accuracy. Similarly, Bolanos and Radeva (2016) implemented deep learning techniques for the Food-101 dataset, focusing on fine-grained food classification. These datasets, however, do not adequately represent Indian cuisine, which consists of many visually similar and non-standardized dishes.

To address food-specific challenges, researchers have introduced multi-task learning systems combining food recognition with portion size and volume estimation. For example, Meyers et al. (2015) presented a system using RGB-D images (with depth information) for more accurate portion estimation, which significantly improves calorie prediction. While such approaches are promising, they require specialized hardware (e.g., depth cameras), which limits their usability in mobile applications.

In the Indian context, there has been limited research. Some recent studies, such as those by Kaur and Kaur (2020), have attempted to classify Indian dishes using CNNs trained on small, self-curated datasets. These studies highlight the need for larger, more diverse datasets and culturally specific food classification models. Additionally, food recognition systems like "IndianFoodImage" and "FoodX-251" have been introduced with limited Indian dish representation but still lack integration with calorie estimation modules.

3. Methodology

The proposed system for estimating the caloric content of Indian food from images is based on a deep learning approach using Convolutional Neural Networks (CNNs). The methodology begins with the preparation of a curated dataset comprising images of common Indian food items. These images were sourced from public datasets, recipe websites, and online food portals, and were annotated with food labels, portion sizes, and corresponding calorie values obtained from reliable nutritional databases such as the Indian Food Composition Tables (IFCT) and the USDA nutrient database. To enhance the quality and diversity of the dataset, we ensured that the images varied in terms of angles, lighting conditions, and presentation styles. Each image was then preprocessed by resizing to a standard input dimension (e.g., 224x224 pixels), normalizing pixel values, and applying data augmentation techniques such as rotation, flipping, and contrast adjustment to simulate real-world conditions and reduce overfitting.

For food classification, we employed CNN architectures including ResNet50, MobileNetV2, EfficientNet-B0, and InceptionV3, utilizing transfer learning by initializing with weights pre-trained on ImageNet. These models were fine-tuned on our Indian food dataset to adapt to domain-specific features. Once the food item was identified, the portion size was estimated either through metadata or visual scale references when available. The final step involved mapping the classified food item and estimated portion size to its caloric content using predefined nutritional data. The system was trained and validated using standard metrics such as accuracy, precision, recall, and mean absolute error (MAE) for calorie prediction. This integrated approach provides a practical solution for automatic calorie estimation of Indian meals and can be extended to mobile applications for dietary tracking and health monitoring.

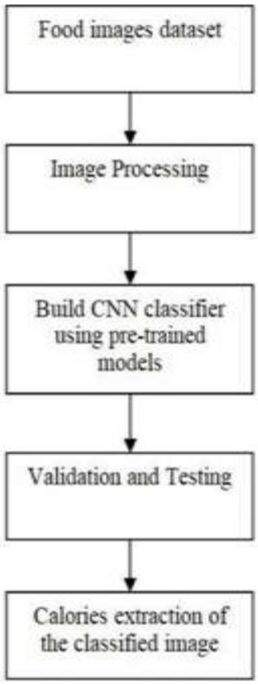

Figure 1: Methodology

Implementation:

The Food calorie estimation consists of five Modules such as Food Image Dataset, Image preprocessing, Training the CNN classifier using pretrained models, Validation and Testing.

A. Food Image Dataset

It contains different classes of food and each class has sample images and text. The dataset inherently comes with a lot of noise since there are images in which there is more than one food item. The image samples also contain a lot of color and few of them are wrongly labeled too. The figure below shows the sample food images from the Indian Food dataset in the text also.

B. Image preprocessing

The dataset contains different classes of food images also in text. Each class of image is divided into training and testing images where in images from each class are considered as training samples and the remaining samples as test samples. Overall, there are training samples and test samples. The training set images are fed to the CNN model and validation is made using the test dataset.

C. Training the CNN classifier using pretrained models

The greater part of the Computer Vision Problems doesn't have exceptionally huge datasets (10,000 images— 50,000 images). In Machine learning early layers will detects edges, middle layers detect the shapes and the last layers will detect some high level data features. These transfer learning models are useful in many computer vision and image classification problems.

D. Validation and Testing

Once the model is trained using the train dataset (the sample of data used to fit the model) then validated using validation dataset (The sample of data used to provide an unbiased evaluation of a model fit on the training dataset while tuning model hyper parameters.) and finally tested using the test dataset.

4. Future Enhancement

While the proposed system demonstrates promising results in calorie estimation of Indian food using Convolutional Neural Networks, there are several avenues for future enhancement to improve accuracy, usability, and scalability. One key area is **portion size estimation**, which currently relies on approximate assumptions or metadata. Integrating depth-sensing technologies (e.g., using dual-camera smartphones or AR-based depth estimation) can provide more accurate volume measurements, leading to better calorie predictions.

Another enhancement involves the expansion and refinement of the **dataset**. Increasing the number of food categories, including more regional dishes and mixed-item plates (e.g., thalis), would improve the model's robustness and generalization. Additionally, developing a **crowd-sourced data collection platform** can help continuously update and diversify the dataset.

Multi-modal learning could also be explored, where image inputs are combined with contextual information such as user-reported ingredients, location, or meal time to improve prediction accuracy. Incorporating **semantic segmentation** techniques to identify multiple food items within a single image can also enhance performance, especially for complex meals.

On the deployment side, creating a **mobile application or web-based interface** would allow users to capture images of their meals in real time and receive immediate calorie feedback. Integrating this with health and fitness apps could provide a holistic dietary tracking solution. Finally, applying **reinforcement learning or continual learning** approaches could help the system adapt over time to individual eating habits, improving personalization and long-term health outcomes.

5. Conclusion

In this study, we proposed a deep learning-based approach to estimate the caloric content of Indian food using Convolutional Neural Networks. Recognizing the challenges posed by the visual complexity and diversity of Indian cuisine, we curated a specialized dataset and implemented CNN architectures capable of classifying food items and predicting their calorie values from a single image. By leveraging transfer learning and data augmentation techniques, our model achieved promising results in recognizing various Indian dishes under real-world conditions. This automated system provides an efficient and user-friendly alternative to manual calorie tracking, particularly for home-cooked or non-standard meals commonly found in Indian diets.

The integration of food classification with portion size estimation and nutritional mapping demonstrates the potential of AI-driven solutions for personalized health monitoring and dietary management. While the current work presents a significant step toward automated calorie estimation tailored to Indian food, future improvements can include the use of multi-view image analysis, depth estimation for more accurate portion control, and the development of a mobile application for real-time usage. Overall, this work lays a strong foundation for culturally adaptive, AI-powered nutritional tools that can support healthier lifestyle choices and improved public health outcomes.

REFERENCES

[1]. Szegedy C, Vanhoucke V, Ioffe S, Shlens J, and Wojna Z. “Rethinking the inception architecture for computer vision”. In Proceedings of the IEEE conference on computer vision and pattern recognition(2021).

[2]. J.D.A Berg and L Fei-Fei, “Large scale visual recognition challenge” (Jan 2018).

[3]. Mohammed A. Subhi and Sawal Md. Ali. “A Deep Convolutional Neural Network for Food Detection and Recognition” (2019).

[4]. O. Russakovsky, J. Deng, H. Su, J. Krause, S. Satheesh,S. Ma, Z.Huang, A. Karpathy, A. Khosla, M. Bernstein “ImageNet Large Scale Visual Recognition Challenge” (2019).

[5]. Lukas Bossard and Matthieu Guillaumin and Luc Van Gool “Food Calorie Measurement Using Deep Learning Neural Network” (2014).

[7]. Gözde ÖZSERT YİĞİT and Buse Melis ÖZYILDIRIM “Comparison of Convolutional Neural Network Models for Food Image Classification” (2018).

[8]. Simon Mezgec, Barbara Korousic Seljak “Nutri Net: A Deep Learning Food and Drink ImageRecognition System for Dietary Assessment” (2017).

[9]. Z. Ning, F. Xia, X. Kong and Z. Chen “Social Oriented Resource Management in Based Mobile Networks” (2016). [10]. M. Artuso and H. Christiansen “Optimizing TCP for Cloud Based Mobile Networks” (2016)