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Food Recognition and Calories Estimation Using AI

Koduri Naga Rishmita, Mukkala Praneeth, Kunchala Naga Karthik Babu, Nagulapati Siva Mukkanti, M. Suresh

Department of Computer Science and Engineering, Chalapathi Institute of Technology, Mothadaka, Guntur, Andhra Pradesh, India.

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KEYWORDS

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ABSTRACT

With the increasing number of health issues reported due to obesity and overeating, people have become cautious about their diet intake to prevent themselves from the diseases such as hypertension, diabetes, and other heart related problem which are caused due to obesity. As per the data shared by WHO, at least 2.8 million people are dying each year because of being overweight or obese. The important part of any healthy diet plan is its calories intake. Hence, we propose a deep learning-based technique to calculate the calories of the food items present in the image captured by the user. We used a layer-based approach to predict calorie in the food item which include Image Acquisition, Food item classification, Surface area detection and calorie prediction. A combination of CNNs and edge segmentation techniques is employed to effectively detect and categorize food objects in images. Furthermore, calorie segmentation is incorporated to provide a robust estimation of the caloric values based on the identified food items. The system utilizes deep learning algorithms to process and analyze food images, segmenting edges to distinguish individual food components for precise calorie calculation.

I. INTRODUCTION

Food object identification systems are an appealing and relevant research area because they allow for objective evaluations of eating behaviour. This capability is useful and appreciated in many diet-related situations, particularly when controlling health issues or analysing the eating patterns of study subjects. To improve a person's eating habits, he or she must be well informed about food and its impact on his or her values (how certain nutrients affect his or her metabolism, blood profile, body composition, and so on). With this information and understanding, an individual can establish an opinion about a certain food product. This enables him or her to elicit the best potential dietary choices (based on his or her values) in times of hunger. Dietary advice and consultation are two methods for changing a person's attitude towards food by increasing his or her knowledge of it. An expert dietitian would normally provide dietary recommendations and eating practices. While this is a terrific way to develop healthy eating habits, the proliferation of multimedia devices and access to vast amounts of information on the Internet necessitates a more economical and automated on-demand system for the public. The increasing usage of mobile phones not only in urban areas but rural areas as well has led to popularization of such applications in a much more widespread manner. Mobile phones have huge potential to make a product or application reach a far wider audience than expected and hence it is only suitable to create an application for this project. Many apps in app stores today are focused on health and fitness. In 2017, there were 32,500 mobile health apps accessible in the major app stores, and this figure is growing. Apps can help to ease the tracking of health-related behaviours and weight management. Furthermore, the widespread use of smart phones and the rapid development of artificial intelligence (AI) technologies have enabled the development of new food identification systems for dietary assessment, which are important for the prevention and treatment of chronic diseases such as type 2 diabetes mellitus and cardiovascular disease, as well as overcoming health issues such as obesity [12]. Some of the pre trained systems available for food recognition are as follows: offer a lightweight system that can conduct the entire food recognition process on the mobile device itself. The region growth algorithm, multi-hypothesis, and ranking categorization distinguish the system from others. As an input, only an image is necessary. To maintain a preset distance from the food object, the user must create an additional target overlay- a circle around the object ”Im2Calories” technique is explained by Meyers and colleagues. In contrast to other systems, this one uses location data to limit the number of feasible categories based on the place the user is currently eating at. One of the best systems for detecting a variety of food groups is the 13 method. The device also provides the geographic location. CNN model is used to categorize features a food object detection system powered by neural networks, is described and constructed by Ming et al. The overall system’s goal is to raise the client’s level of health by connecting them to other medical system.

2. LITERATURE SURVEY

Many works on food recognition based on various visual representations have been presented in recent years. We present an overview of food image recognition in this report. We specifically conducted a systematic review on food picture understanding topics (i.e., recognition, analysis, and retrieval). The following keywords were used in the search queries: ”food recognition”, ”food classification”, ”food portion estimation”, ”food logging”, and ”food image data set”. A few papers were obtained to investigate the various strategies of food recognition utilizing diverse approaches and compare their efficacy based on multiple characteristics. Most food recognition systems have used convolutional neural network based algorithms such as Mask-CNN [2], R CNN, pre-trained CNN models such as VGG-16[5], VGG-19, Resnet[6], Google net, Alexnet[7], Support Vector Machines. These are the most commonly used algorithms used for food recognition systems.

A. Research Gap After looking into the different research papers based on food recognition and calorie estimation it can be said that no system is perfect and each system has its particular downsides. Our system would try to overcome most of the shortcomings in the already existing system such as lack of support for Indian Food Items, High Accuracy on calorie prediction, overall use of data into something meaningful. Many food recognition apps have a limited database of food items that they can recognize. This means that if you are trying to identify a less popular or less well-known food item, the app may not be able to recognize it. Some food recognition apps require access to your camera and other personal data, which may raise privacy concerns. Some food recognition apps are not free, and you may need to pay a fee to use them.

After studying various research papers related to Food Recognition systems, we have understood that most of these systems lack accuracy in detecting the food items, the volume of the food, and calories. The main reason for this problem is the dataset that is being used in these systems contains images of only certain food items and cuisines. The dataset contains only singular items such as fruit or a vegetable and not composite items such as curry or a salad which leads to the incompetence of the system. The new dataset needs to have a vast majority of food groups that are common to most people in India and have a large dataset that can easily help identify these foods. There is also a lack of a properly trained CNN model which leads to the system being inaccurate.

3.SYSTEM ARCHITECTURE

The food calorie estimation system using CNNs involves several key components. First, the system takes an image of the food as input, which is then pre-processed (resized, normalized) to ensure consistency. The CNN architecture processes the image through convolutional layers to extract key features like textures, shapes, and objects. Pooling layers help reduce dimensionality while retaining important features. These features are passed through fully connected layers to make predictions about the food's calorie content, either through classification (identifying food type) or regression (predicting calories directly). Finally, the system outputs the estimated calorie count. The model is trained on a large labelled dataset of food images and their corresponding calorie values to optimize its accuracy.

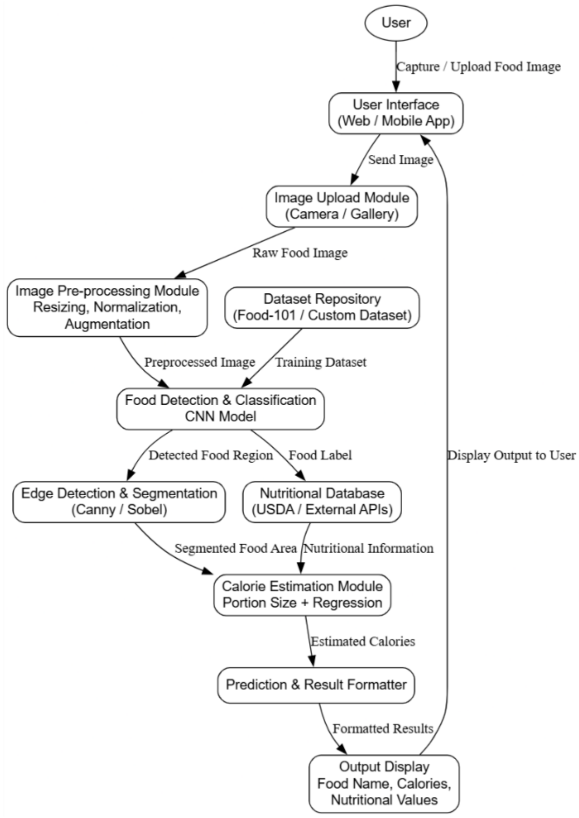

Fig1: System Architecture

4.METHODOLOGY

The proposed Food Recognition and Calories Estimation System using AI follows a structured deep learning pipeline to accurately identify food items and estimate their calorie content from images. The methodology consists of five major stages: Image Acquisition, Pre-processing, Food Classification, Surface Area Detection, and Calorie Estimation.

i.Image Acquisition and Pre-processing

The system begins by capturing a food image using a mobile camera. The acquired image is resized to a fixed dimension (e.g., 224×224 pixels) to maintain uniformity and reduce computational complexity. Pixel values are normalized to improve convergence during training. The normalization process is expressed as:

$$I_{norm} = \frac{I - \mu}{\sigma}$$

where Irepresents the input image pixel values, $\mu$is the mean, and $\sigma$is the standard deviation of the dataset. Data augmentation techniques such as rotation, flipping, and scaling are applied to improve generalization and reduce overfitting.

ii.Food Item Classification using CNN

A Convolutional Neural Network (CNN) is employed to extract spatial features such as texture, color, and shape. The convolution operation is mathematically represented as:

$$F(i,j) = (I * K)(i,j) = \sum_m \sum_n I(i-m, j-n) \cdot K(m,n)$$

where $I$is the input image, $K$is the convolution kernel, and $F(i,j)$is the resulting feature map.

Pooling layers reduce dimensionality while preserving significant features. The extracted features are passed through fully connected layers, and the Softmax activation function is used for classification:

$$P(y = i) = \frac{e^{z_i}}{\sum_{j=1}^{n} e^{z_j}}$$

where $z_i$is the output score for class i, and $n$is the total number of food categories.

iii.Surface Area Detection and Segmentation

Edge detection and segmentation techniques are applied to identify individual food components in the image. Segmentation isolates the food region from the background, enabling accurate estimation of portion size. The surface area is approximated based on pixel density and scale calibration.

iv.Calorie Estimation

Calorie estimation is performed using either regression modeling or a predefined nutritional database. Once the food type and approximate portion size are determined, the calorie value is calculated by:

$$Calories = Portion\_Size \times Calorie\_Density$$

where Portion_Size is derived from surface area estimation, and Calorie_Density is obtained from nutritional datasets.

The model is trained using a large labeled dataset containing food images and corresponding calorie values. Loss functions such as cross-entropy (for classification) and mean squared error (for regression) are used to optimize performance. This layered deep learning framework ensures accurate food recognition and reliable calorie prediction for dietary monitoring applications.

5. DESIGN AND CONSTRUCTION

The proposed Food Recognition and Calorie Estimation system is designed as a mobile-based intelligent application integrated with a deep learning framework. The system architecture consists of multiple interconnected modules including image acquisition, preprocessing, food classification, segmentation, and calorie estimation. A user captures a food image through a smartphone camera, which serves as the primary input to the system. The captured image is then resized, normalized, and enhanced to ensure uniformity and improved feature extraction.

The core component of the system is a Convolutional Neural Network (CNN) model that performs food classification. The CNN extracts important features such as texture, color, and shape through convolution and pooling layers. These features are passed to fully connected layers for accurate identification of the food category. After classification, edge detection and segmentation techniques are applied to isolate the food object from the background and estimate its surface area, which helps determine portion size.

Finally, calorie estimation is performed by combining the identified food category with portion size information using a nutritional database. The calculated calorie value is displayed to the user through the mobile interface, providing an efficient and automated dietary monitoring solution.

6. RESULTS AND DISCUSSION

The proposed AI-based food recognition and calorie estimation system demonstrates effective performance using Convolutional Neural Networks (CNNs). The model successfully identifies food items from images and estimates calorie values by mapping the detected items to nutritional databases. The results indicate that CNN-based approaches are highly efficient in extracting visual features and classifying food categories with good accuracy. The overall system performance is influenced by dataset diversity, image quality, and the reliability of external nutritional sources.

Fig 2: Home Page

The system workflow begins with Figure 2 which provides a structured environment for executing key operations such as dataset upload, preprocessing, train-test splitting, model training, and prediction. This interface ensures smooth interaction and end-to-end processing of food images.

Fig 3: Food Recognition Output

The core functionality is illustrated in Figure 3, where the system identifies food items from input images and links them to nutritional databases for calorie estimation. The model effectively recognizes different food categories and provides approximate calorie values, enabling users to monitor dietary intake.

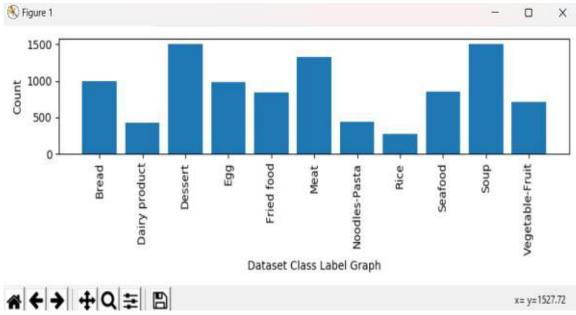

Fig 4: Prediction Analysis Graph

The performance evaluation is presented in Figure 4, which shows the distribution of food classes such as Bread, Dairy, Dessert, Egg, Meat, Rice, Soup, and Vegetables. The CNN model is trained using an 80:20 train-test split and achieves an accuracy of 83% with a loss of 5%, indicating reliable classification performance. The graph also helps identify class imbalance, which can be further optimized to improve model accuracy.

Overall, the system achieves satisfactory performance in food recognition and calorie estimation, with an accuracy of around 83%. The CNN model proves effective in handling image-based classification tasks while maintaining reasonable computational efficiency. However, challenges such as portion size estimation and variations in food appearance still affect calorie prediction accuracy. Future improvements can focus on enhancing dataset diversity and integrating more advanced models to achieve higher precision and real-time applicability.

7. CONCLUSION

We identified the approaches that may be employed to make our system completely functional, user friendly, and accurate by recognising the primary criteria of the Food Recognition System and analysing these requirements in depth. The Current System Analysis enables us to understand how existing systems have used the primary requirements and to what amount of development they have progressed. The many examples allow us to evaluate and analyse the best strategies for developing a Food Recognition System with Calorie Estimation. Finally, the Future Development section Emphasizes how existing systems might be improved and progressed. The Research paper will assist in comprehending the fundamental techniques essential for developing a Food Recognition System.

FUTURE SCOPE

Our project proposes on developing an accurate, quick, easy, cost-free, and visually appealing mobile application featuring an image food recognition system with calorie and nutrition prediction to help users in living a healthy lifestyle. Food image retrieval and classification in future extension such as YOLO (You Only Look Once) or MobileNetV2, to detect and classify the food items in the image. These models can be pre-trained on food-specific datasets like Food-101 to improve accuracy.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

REFERENCES

[1] A. Kumar and S. Sharma, "Real-Time Driver Drowsiness Detection Using Eye Tracking," IEEE Access, vol. 7, pp. 165321–165330, 2019.

[2] T. Ege, Y. Ando, R. Tanno, W. Shimoda and K. Yanai, "Image Based Estimation of Real Food Size for Accurate Food Calorie Esti mation," 2019 IEEE Conference on Multimedia Information Processing and Retrieval (MIPR), San Jose, CA, USA, 2019, pp. 274-279, doi: 10.1109/MIPR.2019.00056.

[3] V. B. Kasyap and N. Jayapandian, "Food Calorie Estimation using Convolutional Neural Network," 2021 3rd International Conference on Signal Processing and Communication (ICPSC), Coimbatore, India, 2021, pp. 666-670, doi: 10.1109/ICSPC51351.2021.9451812.

[4] P. B. Deshmukh, V. A. Metre and R. Y. Pawar, "Caloriemeter: Food Calorie Estimation using Machine Learning," 2021 International Con ference on Emerging Smart Computing and Informatics (ESCI), Pune, India, 2021, pp. 418-422, 10.1109/ESCI50559.2021.9397023.

[5] S. Mezgec and B. K. Seljak, "Using Deep Learning for Food and Beverage Image Recognition," 2019 IEEE International Conference on Big Data (Big Data), Los Angeles, CA, USA, 2019, pp. 5149-5151, doi: 10.1109/BigData47090.2019.9006181.

[6] L. Jiang, B. Qiu, X. Liu, C. Huang and K. Lin, "DeepFood: Food Image Analysis and Dietary Assessment via Deep Model," in IEEE Access, vol. 8, pp. 47477-47489,

[7] 2020,10.1109/ACCESS.2020.2973625.

[8] J. R. Rajayogi, G. Manjunath and G. Shobha, "Indian Food Image Classification with Transfer Learning," 2019 4th International Con ference on Computational Systems and Information Technology for Sustainable Solution (CSITSS), Bengaluru, India, 2019, pp. 1-4,

[9] doi: 10.1109/CSITSS47250.2019.9031051.

[10] Mezgec S, Korouˇ si´ c Seljak B. NutriNet: A Deep Learning Food and Drink Image Recognition System for Dietary Assessment. Nutrients. 2017 June 27;9(7):657. doi: 10.3390/nu9070657. PMID: 28653995; PMCID: PMC5537777.

[11] N. Tammachat and N. Pantuwong, Calories analysis of food intake using image recognition," 2014 6th International Conference on Infor mation Technology and Electrical Engineering (ICITEE), Yogyakarta, Indonesia, 2014, pp. 1-4, doi: 10.1109/ICITEED.2014.7007901.

[12]

[13] F. P. W. Lo, Y. Sun, J. Qiu and B. Lo, "Image-Based Food Classification and Volume Estimation for Dietary Assessment: A Review," in IEEE Journal of Biomedical and Health Informatics, vol. 24, no. 7, pp. 1926 1939, July 2020, doi: 10.1109/JBHI.2020.2987943.

[14] T. T. Tai, D. N. H. Thanh and N. Q. Hung, "A Dish Recognition Framework Using Transfer Learning," in IEEE Access, vol. 10, pp. 7793-7799, 2022, doi: 10.1109/ACCESS.2022.3143119.

[15] R. Yunus et al., "A Framework to Estimate the Nutritional Value of Food in Real Time Using Deep Learning Techniques," in IEEE Access, vol. 7, pp. 2643-2652, 2019, doi: 10.1109/ACCESS.2018.2879117.

[16] Sabiha Samad, Fahmida Ahmed, Samsun Naher, Muhammad Ashad Kabir, Anik Das, Sumaiya Amin, Sheikh Mohammed Shariful Islam, Smartphone apps for tracking food consumption and recommendations: Evaluating artificial intelligence-based functionalities, features and quality of current apps, Intelligent Systems with Applications,Volume 15,2022,200103, ISSN 26673053,https://doi.org/10.1016/j.iswa.2022.200103.

[17] N. Darapaneni et al., "Food Image Recognition and Calorie Pre diction," 2021 IEEE International IOT, Electronics and Mechatronics Conference (IEMTRONICS), Toronto, ON, Canada, 2021, pp. 1-6, doi: 10.1109/IEMTRONICS52119.2021.9422510

[18] Lubura J, Pezo L, Sandu MA, Voronova V, Dons` ıF, ˇ Sic ˇ Zlabur J, Ribi´ c B, Peter A, ˇSuri´ c J, Brandi´ c I, et al. Food Recognition and Food Waste Estimation Using Convolutional Neural Network. Electronics.2022;11(22):3746.https://doi.org/10.3390/electronics11223746.

[19] K. M S, R. R. G and S. Karthik, "Streamlining Load Scheduling in Cloud Computing: A Thorough Performance Assessment and Development of Effective Methods for Design," 2024 International Conference on Advances in Modern Age Technologies for Health and Engineering Science (AMATHE), Shivamogga, India, 2024, pp. 1-7, doi: 10.1109/AMATHE61652.2024.10582239.

[20] Sai Srinivas Vellela, Roja D, NagaMalleswara Rao Purimetla, SyamsundaraRao Thalakola, Lakshma Reddy Vuyyuru, Ramesh Vatambeti, Cyber threat detection in industry 4.0: Leveraging GloVe and self-attention mechanisms in BiLSTM for enhanced intrusion detection, Computers and Electrical Engineering,Volume 124, Part A,2025,110368,ISSN 00457906,https://doi.org/10.1016/j.compeleceng.2025.110368.

[21] K. N. Rao, B. R. Gandhi, M. V. Rao, S. Javvadi, S. S. Vellela and S. Khader Basha, "Prediction and Classification of Alzheimer's Disease using Machine Learning Techniques in 3D MR Images," 2023 International Conference on Sustainable Computing and Smart Systems (ICSCSS), Coimbatore, India, 2023, pp. 85-90, doi: 10.1109/ICSCSS57650.2023.10169550.

[22] S. S. Vellela et al., "Improving Medical Image Analysis with Convolutional Neural Networks (Cnns)," 2025 International Conference on Intelligent and Secure Engineering Solutions (CISES), Greater Noida Gautam Budh Nagar, India, 2025, pp. 579-584, doi: 10.1109/CISES66934.2025.11265231.

[23] S. S. Vellela, L. R. Vuyyuru, K. B. S. K, N. MalleswaraRaoPurimetla, L. Dalavai and M. V. Rao, "A Novel Approach to Optimize Prediction Method for Chronic Kidney Disease with the Help of Machine Learning Algorithm," 2023 6th International Conference on Contemporary Computing and Informatics (IC3I), Gautam Buddha Nagar, India, 2023, pp. 1677-1681, doi: 10.1109/IC3I59117.2023.10397974.

[24] Kavitha Mettupalayam Subramaniam, Ramachandra Rao Goli, Karthik Subburathinam, Srihari Kannan,Optimization of pyrolysis parameters for enhanced biochar production from agricultural biomass: A study on energy efficiency and carbon sequestration potential,Science of The Total Environment, Volume 1015,2026,181362,ISSN 00489697,https://doi.org/10.1016/j.scitotenv.2026.181362.

[25] K. K. Kumar, S. G. B. Kumar, S. G. R. Rao and S. S. J. Sydulu, "Safe and high secured ranked keyword searchover an outsourced cloud data," 2017 International Conference on Inventive Computing and Informatics (ICICI), Coimbatore, India, 2017, pp. 20-25, doi: 10.1109/ICICI.2017.8365348.

[26] V. Khedkar, N. Vullam, J. R. Babu, U. Bhagyalatha, S. Babu Vadde and A. Lakshmanarao, "Hybrid Classification Approach for Heart Disease using Few Shot Inspired Machine Learning Models," 2025 3rd International Conference on Integrated Circuits and Communication Systems (ICICACS), Raichur, India, 2025, pp. 01-05, doi: 10.1109/ICICACS65178.2025.10968965

[27] P. Anusha and J. R. Babu, "Enhancing Radiographic Diagnosis: A Novel AI-based Bone Fracture Detection System," 2025 3rd International Conference on Sustainable Computing and Data Communication Systems (ICSCDS), Erode, India, 2025, pp. 1262-1266, doi: 10.1109/ICSCDS65426.2025.11167456.

[28] R. K. Yarava, G. R. C. Rao, Y. Garapati, G. C. Babu and S. D. V. Prasad, "Analysis on the Development of Cloud Security using Privacy Attribute Data Sharing," 2022 First International Conference on Electrical, Electronics, Information and Communication Technologies (ICEEICT), Trichy, India, 2022, pp. 1-5, doi: 10.1109/ICEEICT53079.2022.9768608.

[29] K. K. . Kommineni and A. . Prasad, "A Review on Privacy and Security Improvement Mechanisms in MANETs", Int J Intell Syst Appl Eng, vol. 12, no. 2, pp. 90–99, Dec. 2023.

[30] Kommineni, K.K., Prasad, A. Enhancing Data Security and Privacy in SDN-Enabled MANETs Through Improved Data Aggregation Protection and Secrecy. Wireless Pers Commun 139, 855–882 (2024). https://doi.org/10.1007/s11277-024-11635-w

[31] "Blockchain-Enabled Secure Data Aggregation for SDN-Enabled Ad-Hoc Networks," International Journal of Intelligent Engineering and Systems, vol. 18, no. 5, pp. 704–717, Jun. 2025, doi: https://doi.org/10.22266/ijies2025.0630.49.

[32] K. K. Kommineni, P. Ande, "Blockchain-driven key management and privacy-preserving data Aggregation Scheme for SDN-enabled MANETs," International Journal of Intelligent Engineering and Systems, vol. 18–18, no. 9, pp. 601–615, 2025, doi: 10.22266/ijies2025.1031.39.