IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 5, May 2023

DOI: 10.17148/IJARCCE.2023.12503

NUTRITION ANALYSIS USING MACHINE LEARNING TECHNIQUES

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Abstract: The importance of food for human survival has been discussed in several medical conferences. Consumers now have more opportunities to learn about nutrition patterns, understand their daily eating habits, and maintain a balanced diet owing to modern dietary evaluation and nutrition analysis tools. Due to the ignorance of healthy food habits, obesity rates are increasing at an alarming speed, and this is reflective of the risks to people's health. People need to control their daily calorie intake by eating healthier foods, which is the most basic method to avoid obesity. However, although food packaging comes with nutrition (and calorie) labels, it's still not very convenient for people to refer to App-based nutrient dashboard systems which can analyze real-time images of a meal and analyze it for nutritional content which can be very handy and improves the dietary habits, and therefore, helps in maintaining a healthy lifestyle. This project aims at building an application that automatically estimates food attributes such as ingredients and nutritional value by classifying the input image of food. This method employs a deep learning model (CNN) for accurate food identification and Food APIs' s to give the nutritional value of the identified food.

Keywords: CNN, GLCM.

I. INTRODUCTION

A. General

Obesity has increased two-fold since 1980 and became the fifth highest cause of death each year. WHO (World Health Organization) noted that about 2.8 million adults every year experience deaths caused by obesity. That is because humans consume food without regard to the need for calories and nutritional content. Some applications such as Coach Noom, Calorie Counter, and Lose It had been developed for the purpose to monitor caloric and nutritional needs. However, that application are not easy to use because before users can use those applications, they must know the name of the food.

B. Deep Learning

Deep learning is a machine learning technique that teaches computers to do what comes naturally to humans: learn by example. Deep learning is a key technology behind driverless cars, enabling them to recognize a stop sign or to distinguish a pedestrian from a lamppost. It is the key to voice control in consumer devices like phones, tablets, TVs, and hands-free speakers. Deep learning is getting lots of attention lately and for good reason. It's achieving results that were not possible before. In deep learning, a computer model learns to perform classification tasks directly from images, text, or sound. Deep learning models can achieve state-of-the-art accuracy, sometimes exceeding human-level performance. Models are trained using a large set of labeled data and neural network architectures containing many layers.

C. Convolutional Neural Network

A convolutional neural network (CNN) is a subset of machine_learning. It is one of the various types of artificial neural networks which are used for different applications and data types. A CNN is a kind of network architecture for deep learning algorithms and is specifically used for image recognition and tasks that involve the processing of pixel data. There are other types of neural networks in deep learning, but for identifying and recognizing objects, CNNs are the network architecture of choice. This makes them highly suitable for computer vision (CV) tasks and for applications where object recognition is vital.

II. LITERATURE SURVEY

A. Simonyan, M. Defferrard, N. Hynes, R. S. Popat, G. P. Pillonetto – 2022, Existing food recognition systems have limited accuracy and are often limited to recognizing only a small set of food items. To develop a food recognition system using Graph Convolutional Networks (GCNs) that can recognize a large number of food items with high accuracy. The authors propose a food recognition system using GCNs that takes as input an image of a meal and outputs a list of the food items present in the meal along with their quantities. The system is trained on a large dataset of food images using a combination of supervised and unsupervised learning techniques.

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J. H. Lee, K. W. Kim, J. H. Lee, Y. H. Kim, J. H. Lee – 2022, Existing food recognition systems have limited accuracy and may be sensitive to factors such as lighting, angle, and occlusion. To develop a food recognition system that is robust to factors such as lighting, angle, and occlusion and achieves high accuracy. The authors propose a food recognition system that uses feature extraction and ensemble learning techniques. The system takes as input an image of a meal and uses feature extraction techniques to extract features such as color, texture, and shape. The system then uses ensemble learning techniques to combine the output of multiple classifiers to predict the food items present in the meal.

Wang, Y., Ding, W., Chen, J., & Zhang, J.-2021, The lack of a simple and efficient method for monitoring daily food intake and nutritional status. To develop a machine learning algorithm that can recognize food images and monitor users' daily food intake and nutritional status. The proposed method uses image processing techniques to extract color and texture features from food images and then applies a support vector machine (SVM) algorithm for classification.

Tellez, E., Krawczyk, B., &L Tannenbaum, M.-2021, The time-consuming and error-prone nature of manual dietary assessment methods. To develop a machine learning algorithm that can accurately recognize food images and estimate their nutritional content for dietary assessment purposes. The proposed method uses a combination of image processing techniques and machine learning algorithms. Specifically, it uses a color-based segmentation technique to extract the food region from the background and then applies a Random Forest (RF) algorithm for classification and regression to estimate the nutritional content.

S. Mohapatra, S. K. Das, and S. S. Meher-2020, authors identified the problem of increasing health issues and the need for a food recognition system that can classify food images accurately. To develop a food image classification system using deep learning algorithms that can run efficiently on mobile devices. The authors used the GoogleNet model for feature extraction and fine-tuned it on their dataset. They also used data augmentation and transfer learning to improve the performance of the model.

N. Gautam, S. Kumar, S. Saini, and R. Khanna-2020, The authors identified the problem of unhealthy food choices and the need for a food recognition system that can help people make better food choices. To develop a food image classification system using deep learning algorithms that can classify food images accurately and help people make healthy food choices. The authors used the VGG16 model for feature extraction and fine-tuned it on their dataset. They also used data augmentation and transfer learning to improve the performance of the model.

Pengcheng Hu, Zhihao Wang, Guohua Wu, Yumei Chen, and Jian Yang-2019, paper identifies the problem of food image recognition for dietary assessment and food recommendation systems. The paper aims to propose a food image recognition system that utilizes a SqueezeNet model with multiple features to improve the accuracy of food recognition. The proposed system uses a SqueezeNet model with multiple features, including color histogram, GIST, and HOG, for feature extraction and food recognition. The system also includes pre-processing techniques such as image resizing and color space transformation. The performance of the system is evaluated on two public datasets, Food-101, and ETHZ Food-101.

T. Arimoto, T. Ogawa, Y. Matsumura, and R. Nakamura-2019, Difficulty in food image recognition due to variations in food appearance and insufficient data for deep learning. To improve the accuracy of food image recognition by incorporating prior knowledge of food categories. The proposed method combines the classification results of a pre-trained deep neural network with the prior probability of the food category. The prior probability is calculated based on the frequency of each food category in the training dataset. The final classification is determined by combining the results of the deep neural network and the prior probability.

R. N. Abd Rahman, N. A. Shukor, N. A. M. Isa, N. A. Zakaria-2018, The authors identified the problem of underreporting in dietary assessments which affects the accuracy of nutrient intake estimation. Traditional methods of dietary assessment rely on self-reported data which are subject to errors, biases, and misreporting. The objective of this paper is to review the current methods and techniques of food recognition and its applications in dietary assessments. The authors conducted a comprehensive review of the literature on food recognition and its applications in dietary assessments.

T. Zhou, Y. Sun, M. Yang, Y. Liu, H. Wang, X. Wang-2018, The authors identified the problem of the time-consuming and error-prone process of traditional dietary assessment methods and the need for an accurate and automated dietary assessment method. The objective of this paper is to develop a deep learning-based food image recognition system for computer-aided dietary assessment. The authors developed a deep learning-based food image recognition system called Deep Food. The system uses the Inception-v3 deep learning model and is trained on the Food-101 dataset.

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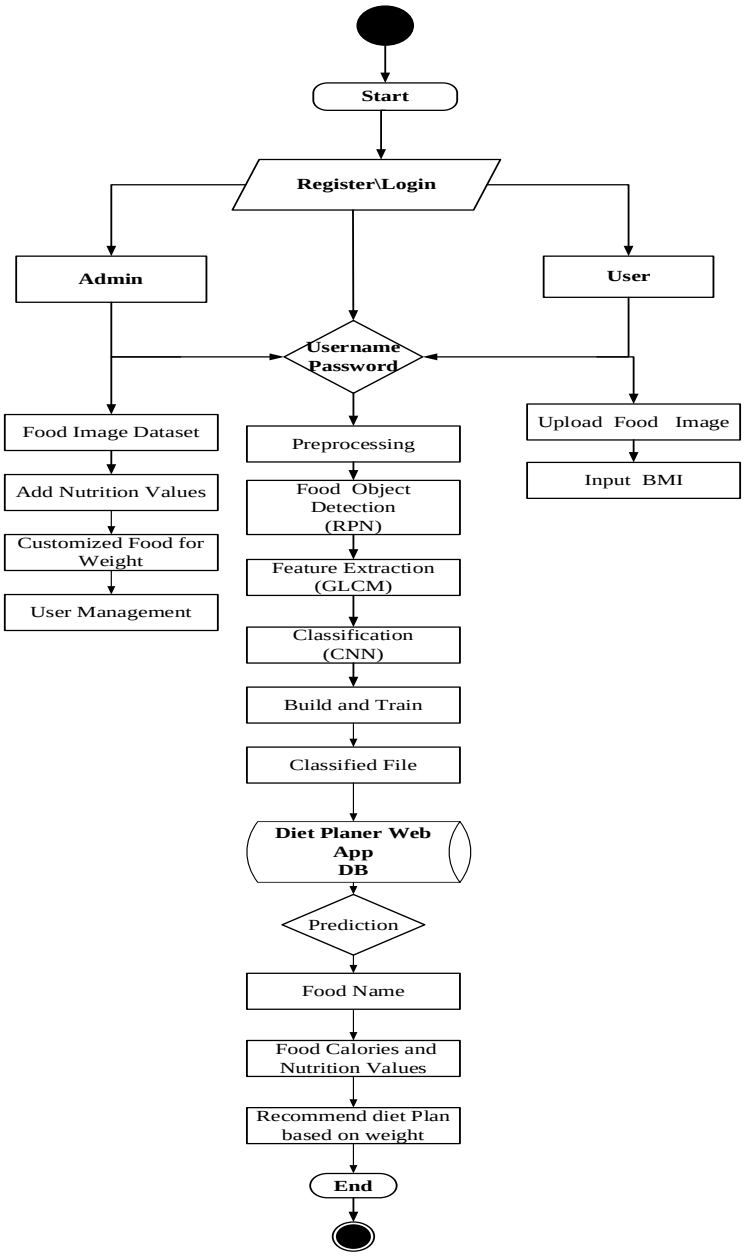
III. PROPOSED SYSTEM

The proposed system "DietPlanner" is a web-based food item prediction system that aims to provide users with a convenient and efficient way to track their calorie and nutrition intake, as well as calculate their BMI and receive personalized diet plans. The system makes use of various computer vision techniques, such as pre-processing, region proposal network (RPN), gray-level co-occurrence matrix (GLCM) feature extraction, and convolutional neural network (CNN) classification. The system takes an input image of food items and pre-processes it using various techniques such as RGB to grayscale conversion, resizing, noise removal using a Gaussian filter, and binarization. Then, RPN is used to detect food in the image and GLCM is used to extract features of the food items such as shape, size, color, texture, and patterns. The extracted features are then fed to a CNN model that classifies the food items such as apples, bananas, tomatoes, and others. The system also measures the calorie and nutrition values of the provided image using a food database and provides a diet plan based on the user's BMI. The user's BMI is calculated using their height and weight, which they can provide during registration. The system also allows users to track their progress by allowing them to input their daily food intake and exercise routines. Overall, the proposed system aims to provide users with a comprehensive tool to manage their diet and achieve their health goals conveniently and efficiently.



3.1. System Architecture

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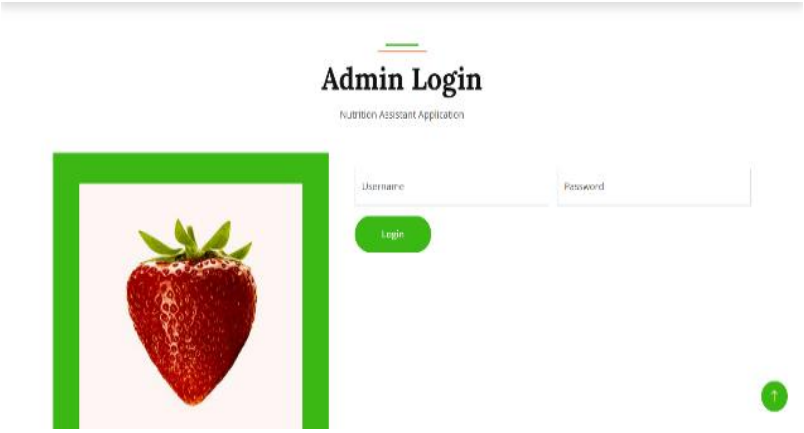
IV. RESULTS

The webpage for diet planning, analyzing the calories of fruits, and calculating the Body Mass Index (BMI) is calculated using the height and weight of the user created and the history of the testing has also been saved.

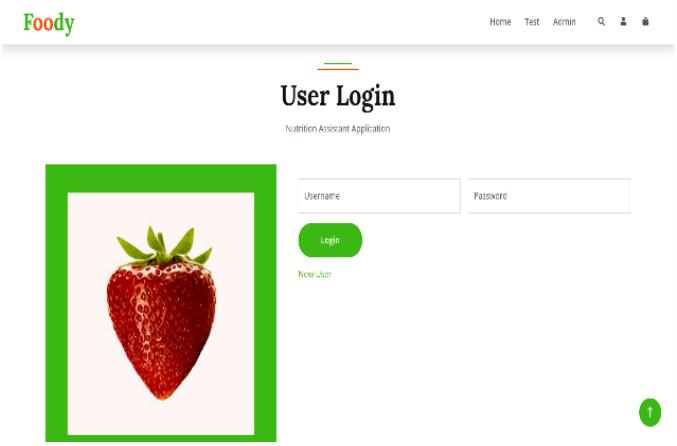
4.1 Home page

It is the home page where the user and the admin can be able to log in and enter the details about them and the details about the webpage.



4.2 Admin login page

On this page, the admin can be login by using the admin name and the password.



4.3 User login page

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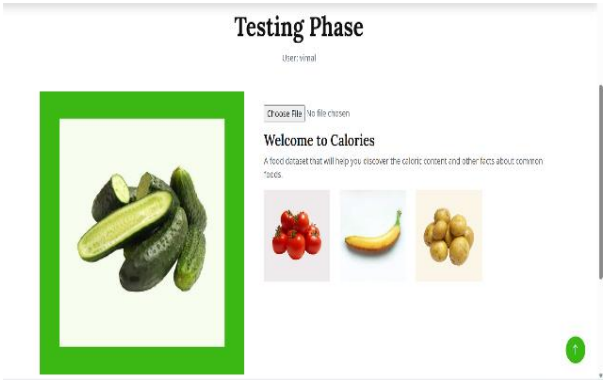
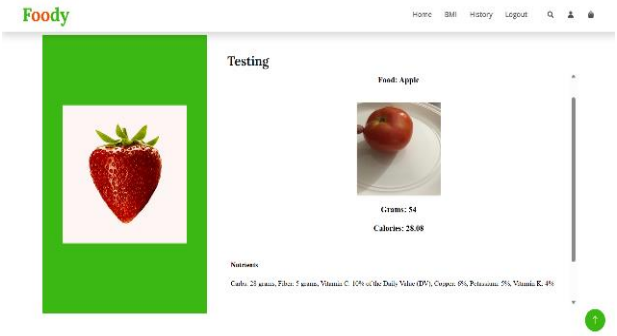
On this page, the user login details will be filled in.



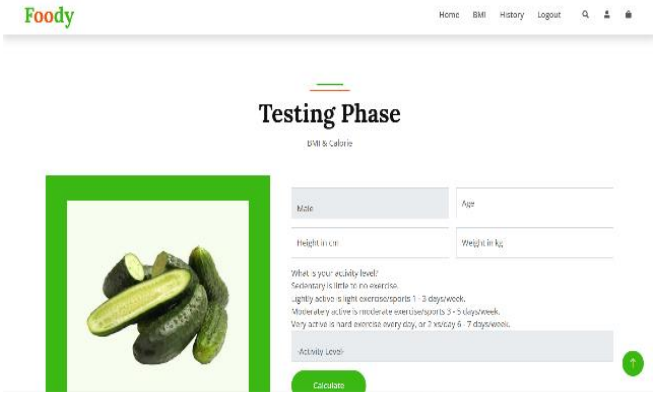
4.4 Testing page

On this page the testing of the fruits takes place and the images of the fruits are needed to analyze the calorie and the testing phase will get done.



4.5 Test results

On this page, the results of the testing phase will be displayed and a description will be given.



4.6 BMI page

On this page, the Body Mass Index (BMI) can be calculated and the calorie of the person can be displayed.

V. CONCLUSION

In conclusion, the "Diet Planner" is a comprehensive web application that allows users to input an image of their food and receive predictions on the food item, its calorie and nutrition value, and a personalized diet plan based on their BMI. The application is built using several modules, including pre-processing (RGB to Grey, Resize, Remove Noise using Gaussian filter, Binarization), food detection using RPN, feature extraction using GLCM, CNN classification, CNN build and train, prediction, food calorie and nutrition calculator, user BMI calculator, diet recommender based on user BMI, diet recommender based on predicted food image and user BMI, notification, and performance analysis.

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The application is designed to be user-friendly and accurate, with performance metrics such as accuracy, precision, recall, and F1 score being measured through the performance analysis module. Overall, the "Diet Planner" is a useful tool for those seeking to make informed dietary choices and maintain a healthy lifestyle.

VI. FUTURE WORK

Integration with wearable devices: The system could be integrated with wearable devices like smartwatches and fitness bands to track the user's physical activity and other vital signs. This would allow for more accurate BMI calculation and diet planning. Collaborating with dieticians and nutritionists: The system could be improved by collaborating with dieticians and nutritionists to include more personalized diet recommendations for users. This could involve incorporating additional user inputs like medical history, dietary preferences, and allergies. Expansion to multi-lingual support: The current system may not be accessible to non-English speaking users. Adding multi-lingual support could increase the accessibility of the system to a wider user base.

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