iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** III **Month of publication:** March 2023

DOI: https://doi.org/10.22214/ijraset.2023.49924

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue III Mar 2023- Available at www.ijraset.com

Analysis of Nutrition Using Image Classification and CNN

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Abstract: ***Food is a necessity for human survival, as evidenced by several medical conferences. People today are more concerned with their diet and food choices to prevent developing or existing ailments. In order to prevent obesity and chronic diseases that are linked to dietary consumption, nutrition management is a crucial component of day-to-day life. Due to people's dependence on smart technologies, using nutrition analysis tools helps individuals understand their everyday eating habits, study nutrition trends, and maintain a balanced diet. In this case, we create a deep prototype food recognition system to examine and research food components from photos of regular meals This research aims to analyze the nutrient content of meals using picture classification. Unlike traditional artificial neural networks, convolutional neural networks can estimate the scoring function directly from image pixels. There are a number of these layers, and the outputs are concatenated at various points to get the final tensor of outputs. We used convolutional neural networks (CNN) to automatically determine the nutritional value of images.***
Keywords: Nutrition Management ,Food recognition ,Convolutional Neural Network.

I. INTRODUCTION

Today's population is becoming more health conscious as a result of a desire to ward off potential or current ailments. Given how reliant society is on smart technology, the availability of an application to automatically track a person's diet is advantageous in many ways. As a result, people become more aware of their eating habits and diets. Using approaches from computer vision and machine learning, research over the past 20 years has been automatically focused on identifying food from photographs and calculating the nutritional value of the meal. To analyse nutritional consumption, the correct estimate of a food's caloric content is crucial. Most individuals eat too much in addition exercise enough. It is easy to lose track of what one consumes. This just highlights the need of appropriately identifying foods. The number of intelligent smartphone applications, including those for iOS and Android devices, has significantly increased recently. They are able to balance people's eating habits and warn them about unhealthy foods. As a consequence of advancements in a lot of the technologies that smart phones employ, their computer power has increased. Due to the slow processing speed of traditional mobile devices, real-time multi-media information must instead be transferred to high-processing servers, which raises connection costs and delay. The research of food categorization is aimed to the creation of real-time applications that take images and quickly hone machine learning models because contemporary smartphones are capable of processing high-quality photographs as well. It is beneficial to avoid conditions like diabetes, high blood pressure, and other problems. Keeping track of the nutrition and calorie content of each meal while facing worries about excessive calorie consumption and preventing diseases like diabetes, high blood pressure, obesity, and others has proven to be the most difficult task. In order to automate nutrition calculation, we developed a plan to develop an algorithm that would use convolutional neural networks (CNN) to evaluate the nutritional content of food products.

II. LITERARY SURVEY

This report examines existing desktop software products in this industry. The algorithm of the developed software product describes the system for selecting a diet that provides adequate nutrition and includes the development of the necessary databases and procedures for diet preparation, evaluation, and structural optimization in accordance with the criteria of minimal deviance from healthy nutrition norms with potential for food interchangeability and compatibility.[1] An effort to create an Android-based food identification software that might be utilized as a health awareness tool for people who are not very health conscious. Photo recognition is a method that determines what food is depicted in the photo. Users must be aware of their needed daily calorie intake by using the Mifflin-St Jeor technique to calculate caloric intake.[2]
This paper presents a simple technique for measuring food calories and nutrients that can assist patients and dietitians in monitoring and controlling daily food consumption.

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Although the method is intended to support dieticians in the treatment of obese or overweight persons, normal people can also gain from it by more carefully monitoring their daily dietary intake.[3]

For the purpose of identifying ingredients from food photographs, a cross-modal variational framework was suggested. A variational mapper network is used to align the distributions created by the image and ingredient encoders after training per-task variational networks, and it is further helped by incorporating their Wasserstein distance in its optimization targets.[4]

To increase accuracy, the picture categorization model is trained using supervised learning. With several real-time test cases in diverse settings, the tool was fully evaluated, and accurate findings were acquired.The tool is user-friendly and provides the necessary feedback visually.[5]

The algorithm begins food item identification inside the bounding boxes that the user has drawn on the screen before beginning to recognise the food items. To better distinguish them, GrubCut is used to segment the area of each food item, extract a colour histogram and SURF-based bag-of-features, and then classify each food item into one of fifty food categories using linear SVM with a fast 2 kernel. The system predicts the direction of food portions where the highest SVM output score is expected to be acquired in order to prompt a user to move a smartphone camera.[6]

A revolutionary mobile phone meal record that measures daily nutrient and food intake is proposed. The tool is used to identify the food consumed during a meal. The mobile device offers a distinctive method for gathering nutritional data that eases the strain on respondents compared to more traditional dietary evaluation methods. In this approach, the food analysis is done through food segmentation, with features used to identify and estimate the portion of the meal.[7]

Based on the study of elements including calories, protein, carbohydrates, objective cost, other nutrients, and nutrition quality, a multi-objective genetic algorithm is suggested. GA is a research approach based on population genetics and natural selection. The model is created using the threpsology theorem to give diverse groups of people suitably well-balanced meals.The best-balanced daily meal group is subsequently given immediately in line with the optimal raw material quantity chosen. Finally, the upgraded food categories achieve the nutrition-matching goal of "nutrition is neither cheap nor costly."[8]

Because of the wide range of containers and backdrops, food identification is a challenging process. Three food region detectors have been developed in this manner. To extract frequency, length, and discrete information among food items, a text-based LOD is suggested. SVM is used to divide food into subregions, and coin recognition is used to estimate the amount. Segmentation rules with promise for non-uniform backgrounds are provided by an algorithm that makes use of past background knowledge. The results of segmentation are improved by creating graphs. The LOD that is suggested outperforms current systems.[9]

To recognise meals and their nutritional composition from a photograph, computer vision and machine learning methods are used. Convolutional neural networks are utilised in this article to categorise the photos. It can estimate the score function directly from image pixels. A kernel for a 2D unsupervised convolution layer with tensor outputs is created. To produce the final tensor of output, all of the tensor outputs are concatenated. To extract features and train the network, a max pooling of data is done. CNNs are best suited for categorizing the images when there are more classes in the dataset.[10]

III. PROPOSED MODEL

In the proposed system, images of food are classified for further diet monitoring applications using convolution neural networks (CNN). We chose CNNs for classification because of their ability of handling large amounts of data. Since the dataset which should be considered for the system consists of vast inputs of data, CNN is efficient for processing. The standard fruits dataset has been selected as the working database for this approach.

A. Dataset

The dataset of foods containing images and categories is required to evaluate the nutrients in the food item. The model needs to be trained and tested using various datasets to give accurate results to the user. The majority of the training and testing video is loaded with noise, vivid color, and incorrectly labeled pictures. The training and testing photos have been labeled correctly.

B. Data Preprocessing

The dataset is pre-processed to address missing values and incorrect data formats, which might affect model accuracy. Before using the data to train the model, the data should be pre-processed. Data cleaning, data transformation, and data reduction are just a few of the processes that make up data preprocessing. This procedure involves transforming the raw data into a format that is both feasible and efficient.

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C. Keras

Keras is an open-source high-level Neural Network framework written in Python that can run on Theano, TensorFlow, or CNTK. It was created by Francois Chollet, a Google developer. It is designed to be user-friendly, expandable, and modular in order to facilitate rapid experimentation with deep neural networks. It supports not only Convolutional and Recurrent Networks independently, but also their combination. Because it cannot handle low-level estimates, it relies on the Backend library to do so. The backend library functions as a high-level API wrapper for the low-level API, allowing it to be run on TensorFlow, CNTK, or Theano. Keras can run on CPUs, NVIDIA GPUs, AMD GPUs, TPUs, and other platforms.

D. Convolutional Neural Network

Convolutional neural networks are a deep learning concept. A class of artificial neural networks is the convolutional neural network. It is mostly used to analyze images. CNN has multilayer perceptrons. A multilayer perceptron is a network in which neurons from one layer are linked to neurons from the next layer. Compared to the other image classification algorithms, CNN is the best accurate algorithm for this nutrition analysis because it uses little pre-processing. When compared to other classification methods, ConvNet requires substantially less pre-processing. The basic methods filters are hand-engineered, and ConvNets can learn these filters/characteristics with enough training.

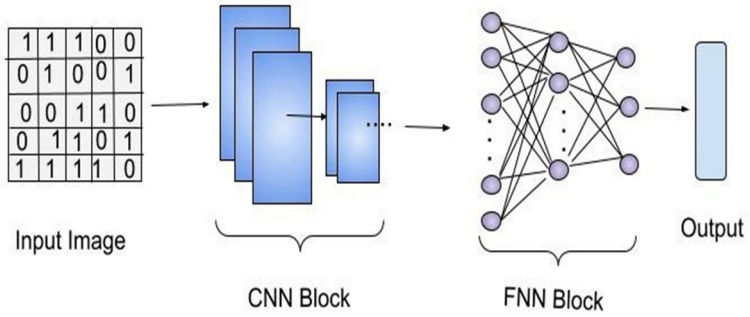


Fig 3.1 Convolutional Neural Network

1) Convolution layer

It is the first layer in convolutional neural networks that extracts features from the input image. A mathematical operation called convolution is done between an image and a filter of a specific size. The Convolution Operation attempts to extract high-level characteristics from the input picture, such as edges. Typically, the first ConvLayer is in charge of capturing Low-Level properties such as edges, colour, gradient orientation, and so on. The architecture adjusts to the High-Level properties as layers are added, giving us a network that has a complete understanding of the images in the dataset. The output of this layer is feature map that is passed on to the next layers. Two parameters are used to define convolutions:

a) The size of the extracted tiles (typically 3x3 or 5x5 pixels).
b) The number of filters used is reflected in the depth of the output feature map.

2) Pooling Layer

This is layer is used to minimize the dimensions of the feature map produced in the convolution layer. Thus, it reduces the number of parameters and the computational costs in the network. It summarizes the features from the output generated by the convolution layer. The types of pooling operations are Max Pooling and Average Pooling.

a) In max pooling, the maximum value (important feature) is extracted from the feature map.
b) In average pooling, the average of the elements covered by the filter is calculated.

3) Fully Connected Layer

This layer is often found before to the output layer, and the neurons in this layer are completely coupled to the neurons in the preceding and subsequent layers. The features retrieved by the convolutions are used to execute the classification procedure. The layers are linked because two completely connected layers outperform a single one.

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4) Dropout Layer

When all of the features in the training dataset are linked to the fully connected layer, overfitting occurs. When new data is introduced, overfitting has a detrimental influence on model performance. A few neurons are removed from the network, resulting in a smaller model. As the network is simplified, the model's performance improves.

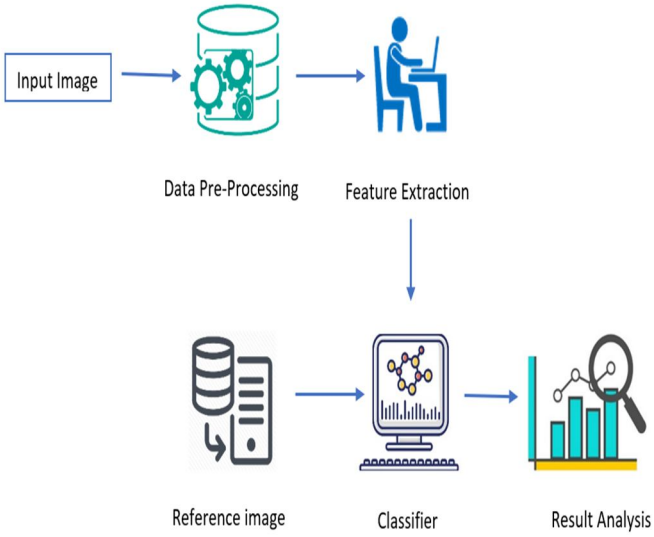


Fig 3.2 System Architecture

IV. CONCLUSIONS

People all throughout the world are paying more attention to their health. Because algorithms for completing this task are continually being created and enhanced, various and complementary datasets for assessment are not only beneficial but also required to facilitate research. High-calorie consumption can lead to diabetes, high cholesterol, heart attacks, high blood pressure, and other health problems. To address this, we created a web application that offers health information on what we eat. This web-based tool takes a picture of food and calculates its nutritional worth. Future work in this subject could involve a practical application of this work, as well as more upgrades and sophisticated features, to make it a complete user guide.

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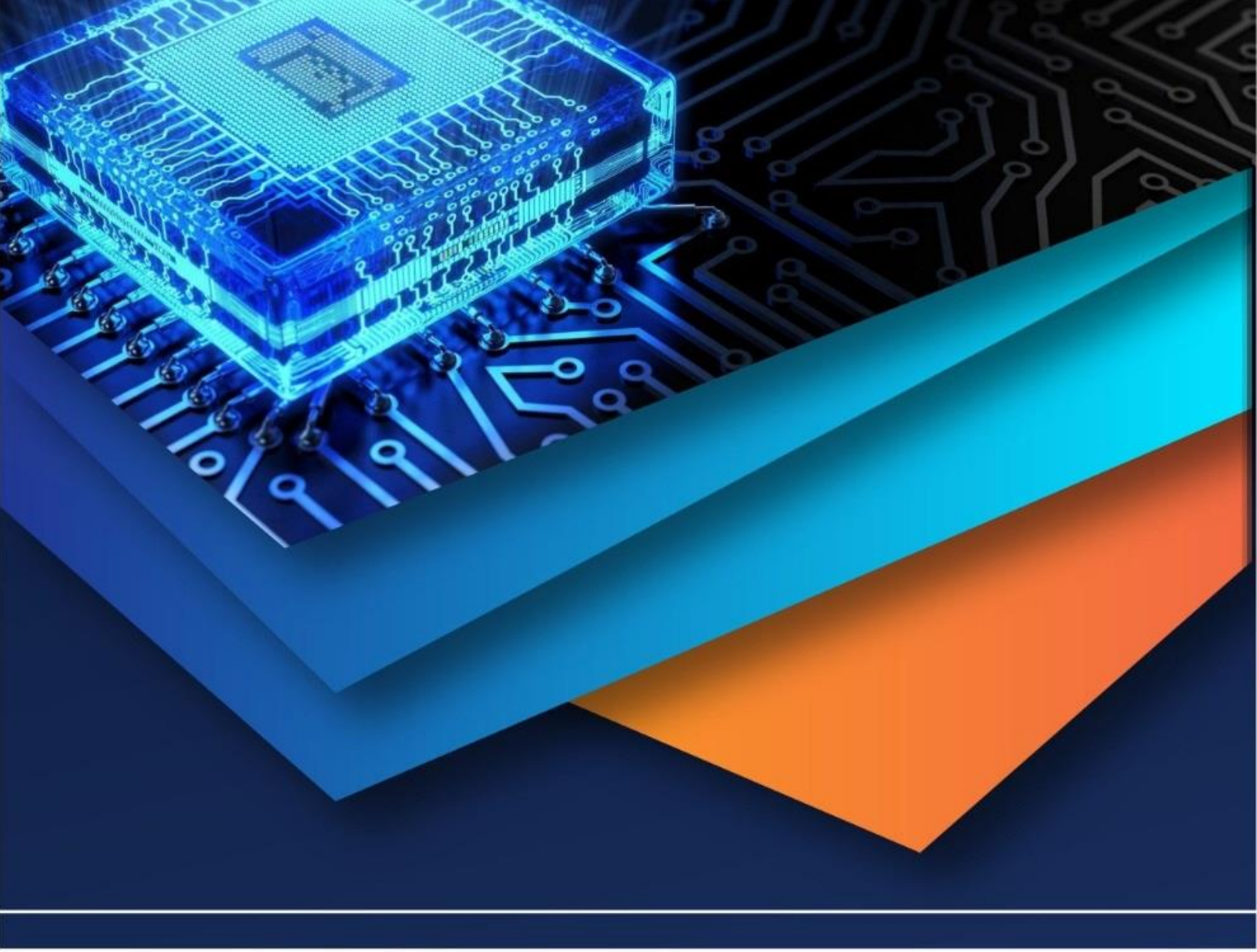
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