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Image-based Food Classification and Volume Estimation for Dietary Assessment

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Abstract: *The past few years, there has been significant progress in the recognition of food images. The work by Viswanath C, et al. proposed a method to classify images of Indian food by using a Convolutional neural networks (CNNs) model based on Google Inception-V3. In this instance, a convolution layer that can produce its own convolution kernel was used to convolve with the input layer and produce the tensor outputs. A model centered on estimating the number of calories in the food item by using only its image as input was put out by Hemraj Raikwar, et al. [6]. An autonomous food identification system that can identify various Indian foods was proposed by Patanjali C, et al [9]. The suggested food identification system is designed to be able to categorize Indian food items using both SVM and KNN, two separate classification methods.*

Keywords: Indian food, Convolutional Neural Network, Machine Learning, Google Inception V-3, convolution kernel, SVM KNN

I. INTRODUCTION

Training of CNN for image classification can be done mainly in 2 ways: training the CNN from the scratch or using the concept of transfer learning. Transfer learning is a deep learning technique where a model is trained to learn and store the knowledge from one problem and use the same model to other similar problems. i.e., fine tuning already trained CNN models from the huge dataset to food image classification task. Through this research an effort has been put to classify food images into their respective classes using machine learning. Image Classification with deep learning techniques such as Convolution neural network are getting incredible consideration because of their efficiency in learning and classifying complex features. A comparison has been made between the models with respect to accuracy and validation loss. Statistics show that 95perent of the people do not follow any nutritional plan as these are very strict and restricts people from consuming their day to-day food. Old aged who want to monitor their food intake, patients who want to monitor their health through food due to different dietary restrictions and mainly youth who want to track the calories and nutrition intake to maintain fitness, the importance of food classification has increased. Over the past couple of years, image based dietary and calories extraction has been a challenging task and a lot of research is going on the same.

II. LITERATURE SURVEY

Paper Name: Food Classification from Images Using Convolutional Neural Networks
Author: David J. Attokaren, Ian G. Fernandes, A. Sriram, Y.V. Srinivasa Murthy, and Shashidhar G. Koolagudi
Abstract: In this paper, an approach has been presented to classify images of food using convolutional neural networks. Unlike the traditional artificial neural networks, convolutional neural networks have the capability of estimating the score function directly from image pixels. A 2D convolution layer has been utilised which creates a convolution kernel that is convolved with the layer input to produce a tensor of outputs. There are multiple such layers, and the outputs are concatenated at parts to form the final tensor of outputs. They also use the Max- Pooling function for the data, and the features extracted from this function are used to train the network. An accuracy of 86.97% for the classes of the FOOD-101 dataset is recognised using the proposed implementation

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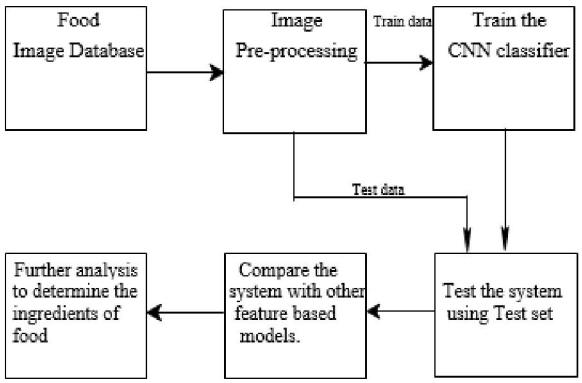

Fig. Proposed System Block Diagram

Paper Name: Deep Convolutional Generative Adversarial Network Based Food Recognition Using Partially Labelled Data

Author: Bappaditya Mandal , N. B. Puhan and Avijit Verma

Abstract: In this work, they have proposed a semi-supervised GANs based on deep convolutional neural network architecture approach to alleviate the shortcomings posed by lack of labelled images and the classical image recognition problems in food datasets. They have performed experiments on the largest real-world food images ETH Food-101 dataset and the Indian Food dataset with partially labelled data. Experimental results show that the generative semi-supervised deep CNN approach proposed in this work outperforms the current state-of- the-art methodologies consistently for all the ranks for both the datasets even with partially labelled data. While GANs have the potential to improve the food recognition accuracy with partially labelled data, it is difficult to achieve stability and convergence during training. In future, they would try to improve the recognition accuracy with better and robust GAN architecture that could further reduce the usage of labelled training data

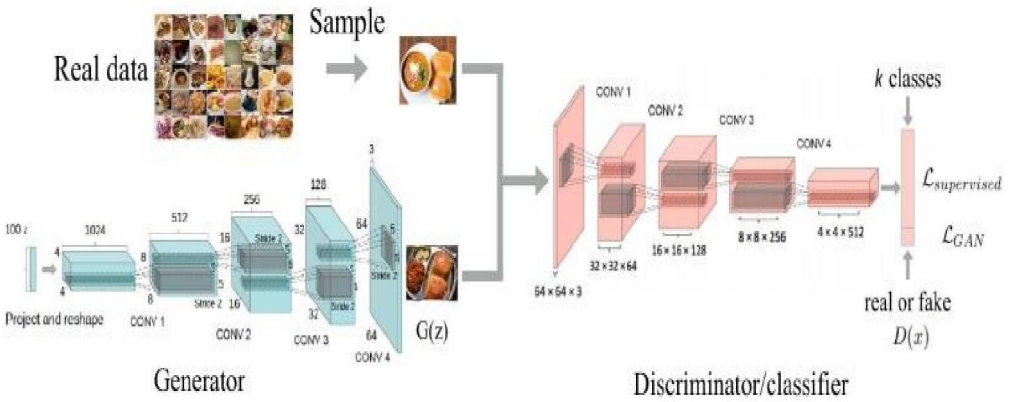

Fig. Proposed System Block Diagram

Paper Name: Few-shot and Many-shot Fusion Learning in Mobile Visual Food Recognition

Author: Heng Zhao , Kim-Hui Yap , Alex C. Kot , Lingyu Duan , Ngai-Man Cheung

Abstract: In this paper, they propose a fusion learning of few-shot and many-shot for mobile visual food recognition. It is able to learn a new food category using the few-shot framework, and also recognize the categories of many-shot training. They evaluate the performance of the proposed method on a new Indian food dataset called NTU-IndianFood107, where they demonstrate the effectiveness of the proposed fusion learning on handling both few-shot and many-shot food images at the same time.

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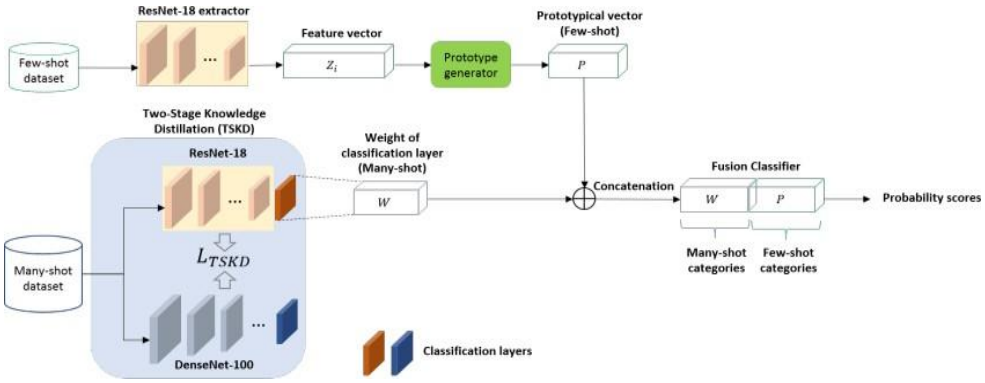

Fig. Proposed System Block Diagram

Paper Name: Indian Food Image Classification with Transfer Learning
Author: Rajayogi J R,Manjunath G, Shobha G
Abstract: In this research study, the Convolutional Neural Network, a Deep learning technique is used to classify the food images in to their respective classes. The dataset considered is the Indian food dataset and they were able to achieve accuracy of 87.9% in case of the inception V3 model compared to other models such as the VGG19 that produced 78.9%. The VGG16 model and the ResNet model were able to produce accuracy of 78.2% and 69.91% respectively.

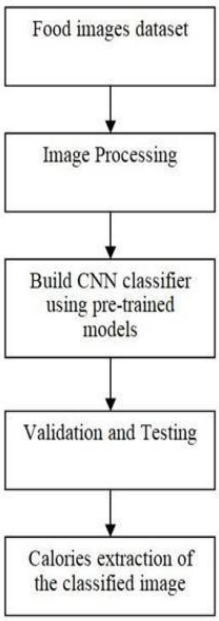

Fig. Proposed System Block Diagram

Paper Name: Food Image Classification with Convolutional Neural Network
Author: Md Tohidul Islam, B.M. Nafiz Karim Siddique, Sagidur Rahman, Taskeed Jabid
Abstract: In this paper they tried to classify food images using convolutional neural network. Convolutional neural network extracts spatial features from images so it is very efficient to use convolutional neural network for image classification problem. Recently people are sharing food images in social media and writing review on food. So, there is a lot of food image in the social media but some image may not be labelled. It will be very helpful for restaurants if they can advertise their food to those people who is looking similar kind of foods they offer. They developed a convolutional neural network model to classify food images in food-11 dataset
They also used a pre-trained Inception V3 convolutional neural network model to classify food images.

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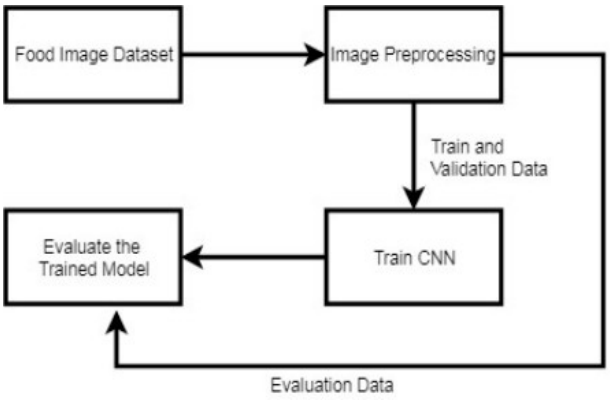

Fig. Proposed System Block Diagram

Year	Title	Implementation	Accuracy
2017	Food Classification from Images Using Convolutional Neural Networks	Implement With CNN Algorithm	86.97%
2018	Deep Convolutional Generative Adversarial Network Based Food Recognition Using Partially Labelled Data	Implement with Generative Adversarial Network, Deep CNN, Semi-Supervised Learning,	70-90%
2019	Few-shot and Many-shot Fusion Learning in Mobile Visual Food Recognition	Implement with Few- shot learning, Fusion learning, Compact network	72.0%
2019	Indian Food Image Classification with Transfer Learning	Implement with Convolutional neural network, Google inception v3 model, VGG16, VGG19, ResNet, Transfer learning	87.9%
2018	Food Image Classification with Convolutional Neural Network	Implement with CNN, Computer Vision, Deep Learning	82.07%

III. METHODOLOGY

CNN Algorithm

Convolutional Neural Networks specialized for applications in image & video recognition. CNN is mainly used in image analysis tasks like Image recognition, object detection & Segmentation.

There are Three types of layers in Convolutional Neural Networks:

- Convolutional Layer: In a typical neural network each input neuron is connected to the next hidden layer. In CNN, only a small region of the input layer neurons connects to the neuron hidden layer.
- Pooling Layer: The pooling layer is used to reduce the dimensionality of the feature map. There will be multiple activation & pooling layers inside the hidden layer of the CNN.
- Fully-Connected layer: Fully Connected Layers form the last few layers in the network. The input to the fully connected layer is the output from the final Pooling or Convolutional Layer, which is flattened and then fed into the fully connected layer

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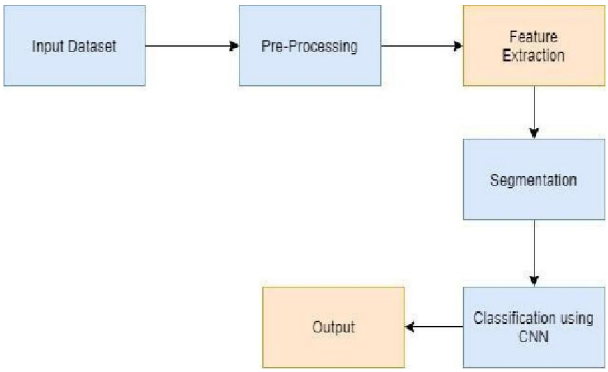
IV. SYSTEM ARCHITECTURE



Dataset - Offer a dataset for a machine that does not see data the same way that people do, the data acquired should be made standard and intelligible. The image data set that was used in this study is a collection of images of human disease. The dataset is divided between train and test groups at a ratio of 80:20.

Pre-Processing: Preparing raw data to be acceptable for a machine learning model is known as data preparation. In order to build a machine learning model, it is the first and most important stage.It is not always the case that we come across the clean and prepared data when developing a machine learning project. Additionally, any time you work with data, you must clean it up and format it. Real-world data typically includes noise, missing values, and may be in an unusable format, making it impossible to use machine learning models on it directly. Data preprocessing is necessary to clean the data and prepare it for a machine learning model, which also improves the model's accuracy and effectiveness

Feature Extraction: A dimensionality reduction technique called feature extraction divides a large amount of raw data into smaller, easier-to-process groups. These huge data sets share the trait of having many variables that demand a lot of computational power to process. The term "feature extraction" refers to techniques for choosing and/or combining variables into features, which significantly reduces the amount of data that needs to be processed while accurately and fully describing the initial data set.

Segmentation: Image segmentation is a technique that divides a digital image into various subgroups known as Image segments, which helps to simplify further processing or analysis of the image by reducing the complexity of the original image. In plain English, segmentation is the process of giving pixels labels. Each pixel or element of a picture assigned to the same category has a unique label.

Classification: It is possible to do classification on both structured and unstructured data. Classification is the act of categorizing a given set of data into classes. Predicting the class of the provided data points is the first step in the procedure. The terms target, label, and classes are frequently used to describe the classes. The task of approximating the mapping function from discrete input variables to output variables is known as classification predictive modeling

V. RESULT

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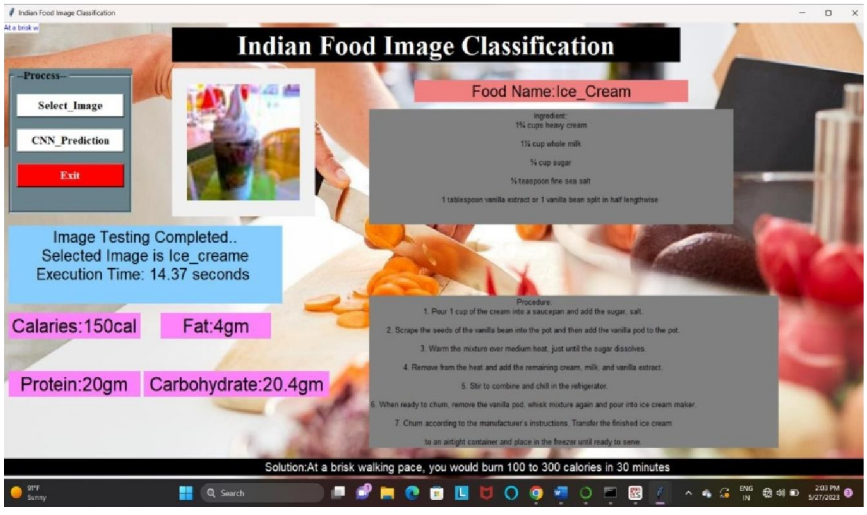

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VI. Conclusion

The Convolutional Neural Network, a Deep Learning approach, is employed in this suggested system to classify the food photos into the appropriate classes. The Indian cuisine dataset, used to train the CNN algorithm, is the dataset under consideration. Due to the lack of information regarding diet and calorie needs, it is essential to have a system that records daily food intake for a healthy diet. Correct food identification is another difficulty. As a result, we suggested a measurement technique to determine the number of calories from various food images by measuring features like the food's colour from the image. When calories are calculated for multi-food and complex food items, the proposed system will be improved, allowing users of our application to understand the complexities of food more fully.

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