A FRAMEWORK TO ESTIMATE THE NUTRITIONAL VALUE OF FOOD IN REAL TIME USING DEEP LEARNING TECHNIQUES

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ABSTRACT: There has been a rapid increase in dietary ailments during the last few decades, caused by unhealthy food routine. Mobile-based dietary assessment systems that can record real-time images of the meal and analyze it for nutritional content can be very handy and improve the dietary habits and, therefore, result in a healthy life. This paper proposes a novel system to automatically estimate food attributes such as ingredients and nutritional value by classifying the input image of food. Our method employs different deep learning models for accurate food identification. In addition to image analysis, attributes and ingredients are estimated by extracting semantically related words from a huge corpus of text, collected over the Internet. We performed experiments with a dataset comprising 100 classes, averaging 1000 images for each class to acquire top 1 classification rate of up to 85%. An extension of a benchmark dataset Food-101 is also created to include sub-continental foods. Results show that our proposed system is equally efficient on the basic Food-101 dataset and its extension for sub-continental foods. The proposed system is implemented as a mobile app that has its application in the healthcare sector. Keywords: Deep learning, Nutritional value, DL techniques.

1. INTRODUCTION: High Calorie food intake can be harmful and result in obesity, which is a preventable medical condition that causes abnormal accumulation of fat in the body. It can result in numerous diseases such as obesity, diabetes, cholesterol, heart attacks, blood pressure, breast, colon and prostate cancers and other diet-related ailments. In order to deal with such problems, people are inclined towards making a difference in their diet plans by paying more attention to what type of food they are consuming. Diet management is a key concern amongst individuals belonging to different age groups. However, one major challenge in diet management is to maintain a balance between what one eats and how one monitors his/her food consumption. The immense increase in ailments such as high cholesterol, blood pressure, strokes etc. demand for nutritional and diet management for which people resort to expensive nutrition therapies. It is a known fact that energy balance plays a pivotal role in maintaining a healthy weight and lifestyle. If people become more aware about their food intake and its nutritional value, then the diseases mentioned above and allergies can be reduced. This work aims to develop a mobile application that can record real time images of meal and analyze it for nutritional content, so that people can improve their dietary habits and lead a healthy life In visual object recognition tasks, Convolutional Neural Networks (CNN) have found great success and therefore CNNs are also employed for recognizing food items present in an image[10]. In this work, we employ CNNs to acquire top 1 recognition accuracy rates of 85%. Another challenge is in the accurate computation of ingredients and nutritional value of the food. Our goal is to minimize the user input and automate this task as much as possible. We employ deep neural

networks for estimating the ingredients and the attributes of the food. Our focus not only revolves around attributes like protein, calcium or vitamins etc. but also includes ingredients present in the food items. Our system automatically estimates food attributes, food ingredients and nutritional content[12].

2. LITERATURE SURVEY: Mobile devices are evolving rapidly. Every season, new generation of mobile devices are release that are more capable and computationally powerful than the previous generation. Along with the rapid growth of wireless internet technologies that promise high data rate and massive device connectivity, mobile multimedia services and applications can transform the healthcare sector. Numerous studies have been conducted to study the impact of mobile applications in healthcare processes. Similarly, the use of social media for health-related purposes has also been research upon. Personal health apps are also driving a mobile revolution in health care. In this section, we briefly review the different methods for measuring food intake[11]. Methods for measuring food intake range from manual dietary assessments to automatic sensing methods. In this section, we briefly review the automatic imaging based methods. Pouladzadeh et al. proposed a system that involves capturing an image of the food and processing it through predefined steps, which follow a pipe line architecture. These steps include food image segmentation and food portion recognition. Calorie measurement is done using nutritional fact tables. The system often fails to detect various food portions in mixed food; it also fails to segment them properly. The area measurement technique proposed is based on a depth estimation technique. However, their system uses a dataset that is too simplistic, consisting of food items placed on white plates with smooth texture. Chen et al. use a depth camera such as Kinect to estimate the volume of food for calorie measurement. However, dependency of their system on Kinect makes the algorithm unsuitable fornormal use[13]. Model-based measurement of food portion size is proposed in The method consists of three stages i.e. base plane localization, food segmentation and volume estimation. A 2D-3D model to image registration scheme is used for volume estimation. The algorithm does not perform accurately in cases of shadows, reflection, complex food, ingredients and motion blurring[14]. Fang et al. [29] use special fiducial markers placed in the scenes to estimate the food portion size. Im2calorie [30] estimates food categories, ingredients and volume of individual dishes and calories. However, the calorie annotated dataset used is not sufficient. The main approach for calorie estimation in the above mentioned methods is to start off by recognizing the food category, followed by food portion size estimation and finally calorie estimation using standard nutritional fact tables. There are other approaches that directly estimate the calories from food images. Ege and Yanai directly estimate food calories from photos of food by simultaneously learning about food categories, ingredients and cooking directions. They argue that simultaneous learning of categories, ingredients and calories will boost performance as there exists a correlation between them. Various approaches have also been proposed for food recognition only. Ahmed and Ozeki propose two methods to recognize food. These methods include Speeded up Robust Features (SURF) and Spatial Pyramid Matching (SPM). The former method (SURF) requires a dictionary of code words, and histograms are generated against those code words

using a linear kernel classification scheme. The latter (SPM) accounts for spatial information by dividing and subdividing the given image into increasingly smaller sub regions and computing histograms in each. Kawano and Yanai propose a real time mobile food recognition system, which continuously acquires frames of the image from the camera device. The user draws boxes around the food items on the screen and food recognition is carried out within the boxes. The graph cut based segmentation algorithm GrabCut is used for accurate food segmentation. Recognitions is performed using the linear kernel SVM (support vector machine). Camera position and viewing direction need to be maintained to obtain more reliable SVM classifications. Convolutional neural network have also been employed for the recognition task and as a result the recognition accuracy has improved significantly

3. SYSTEM ANALYSIS:

Existing System: Most of the existing systems, often implemented as smart phone applications (e.g. MyFitnessPal, SHealth) help users to keep track of their food intake. These systems assist users in achieving dietary goals such as weight gain/loss, allergy management or maintaining a healthy diet. However, they require users to manually input the food details along with the portion sizes. This can be very tedious and time consuming, resulting in users to refraining from using these applications for long periods of time. Furthermore, naive users rely on self reports of calorie intakes which often are misleading. Similarly, relies on expert nutritionists to analyze images everyday. There are approaches that use mobile phone cameras to automatically recognize the food. However, the task of food attributes measurement is not carried out. In other methods, recognition of food is followed by food volume estimation and then calorie computation. However, the volume measurement procedure is very tedious and prone to errors. Secondly, such algorithms are applied to simple food items. Crowd sourcing is also employed for the nutritional analysis of food items [16] which makes the algorithm costly and inhibits it from widespread application in daily life.

Disadvantages: High Calorie food intake can be harmful and result in obesity, which is a preventable medical condition that causes abnormal accumulation of fat in the body.

Proposed System: The proposed system aims to be a step towards creating awareness based on health and fitness concerns so that people can eat and live in a better way. The proposed method helps in determining the nutritional content of food automatically by making it feasible for a person to learn about what food might contain and how healthy it might be. The inherent theme is to automatically detect food items from an image of a platter and then estimate the respective food attributes such as the percentage of calcium, iron etc. along with the ingredients present in the food. Our system provides nutrition facts similar to packaged food items. The proposed system has its application in health-care industries and hospitals. Knowing about the nutritional value will further provide motivation for patients to refrain from food that can be detrimental to their health. The proposed system consists of two components. The first component uses CNNs to recognize the food item in an image. The second component estimates food attributes using text retrieval from internet archives as well as scrapping of data from nutritional and recipe websites for ingredients and nutrient counts. This data is trained

on a two layer neural network, from which we can compute probabilities of existing ingredients in a particular food item. Each food item typically has a standard serving size against which calories and nutritional content can be calculated.

4. IMPLEMENTATION:

Modules: Data Set Preparation Data Training Model Generation Food Reorganization Nutrition detection Data Set Preparation Dataset preparation and preprocessing Data is the foundation for any machine learning project. The second stage of project implementation is complex and involves data collection, selection, preprocessing, and transformation. Each of these phases can be split into several steps.

Data collection It‟s time for a data analyst to pick up the baton and lead the way to machine learning implementation. The job of a data analyst is to find ways and sources of collecting relevant and comprehensive data, interpreting it, and analyzing results with the help of statistical techniques. The type of data depends on what you want to predict. There is no exact answer to the question "How much data is needed?" because each machine learning problem is unique. In turn, the number of attributes data scientists will use when building a predictive model depends on the attributes‟ predictive value. „The more, the better‟ approach is reasonable for this phase. Some data scientists suggest considering that less than one-third of collected data may be useful. It‟s difficult to estimate which part of the data will provide the most accurate results until the model training begins. That‟s why it‟s important to collect and store all data — internal and open, structured and we can also complement their own data with publicly available datasets. For instance, Kaggle, Github contributors, AWS provide free datasets for analysis.

Labeling Supervised machine learning, which we‟ll talk about below, entails training a predictive model on historical data with predefined target answers. An algorithm must be shown which target answers or attributes to look for. Mapping these target attributes in a dataset is called labeling.

Data Training: After a data scientist has preprocessed the collected data and split it into three subsets, with training data. An algorithm will process data and output a model that is able to find a target value (attribute) in new data — an answer you want to get with predictive analysis. The purpose of model training is to develop a model. he or she can proceed with a model training. This process entails "feeding" the algorithm Two model training styles are most common — supervised and unsupervised learning. The choice of each style depends on whether you must forecast specific attributes or group data objects by similarities.

Model Generation: The goal of this step is to develop the simplest model able to formulate a target value fast and well enough. A data scientist can achieve this goal through model tuning. That‟s the optimization of model parameters to achieve an algorithm‟s best performance.

Food Recognition: In this module we can test the food image in generated model to predict the food.

Nutrition detection: In this module we are fetching the nutrition values using web APIS, for detected food in images. **Advantages:** The inherent theme is to automatically detect food items from an image of a platter and then estimate the respective food attributes such as the percentage of calcium, iron etc.

ARCHITECTURE

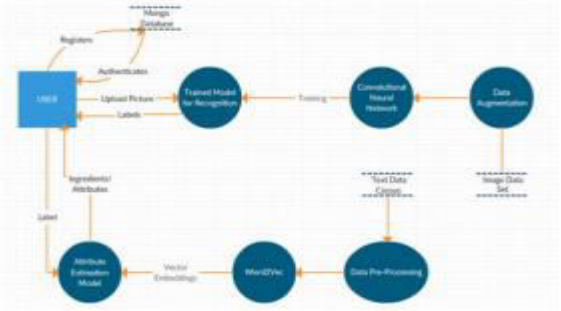

Fig-1: Architecture

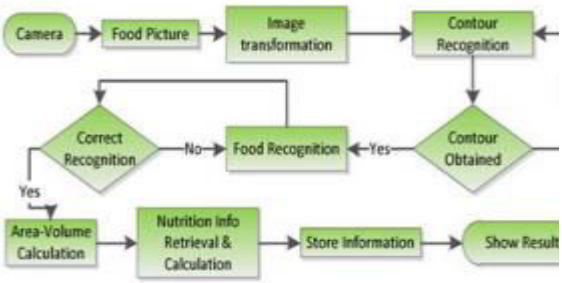

Fig-2: System Flow

CONCLUSION: This paper presents a system that exploits the extensive use of mobile devices to provide health information about the food we eat. The mobile-based app takes the image of the meal and presents approximate ingredients and nutritional values in food. A dataset is created that consists of common and subcontinental food items. We employ a fine tuned Inception model to recognize food items and propose a method to estimate attributes of the recognized food item. The results are improved via data augmentation, multicrop evaluation, regularization and other similar techniques. 85% accuracy is achieved on our dataset. Our proposed method for estimating attributes also achieved encouraging results. Future endeavors in this domain can include the practical application of this work and more improvements in the android application with advanced features to make it a complete guide for everyday meals.

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