Estimation of Food Nutrition using Machine Learning

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Abstract- *The objective of this project is to develop a nutrition calculator and provide the information of nutrients present in the food item. The main purpose of this proposed system is to improve the accuracy of pre-training model. This system focuses mainly on the estimation of calories and other nutrients present in food. This whole thing will be automated as contrasting to existing system where the user needs to manually distribute the values. However, users will only need to click on the image of food and provide it as an input to the system. Further processes can be computerized quickly, with the use of algorithm available for each food and setting item and to get the outline of each food. Then the volume of individual food item is determined by using proper formulas and algorithms. At the end, it estimates the calories and nutrients present in that food and experimental studies have shown that by providing product with information of calories and nutrients present in the food items the proposed nutrients estimation method is effective.*
Keywords: *CNN, Image Segmentation, Image Processing*

I.   INTRODUCTION

Food is the key element of every human body. So, diet must be always taken into consideration. The knowledge about total intake of calories and nutrients to be consumed to maintain a fit and healthy life is needed. But, in most of the cases, unfortunately people face difficulties during estimation and measurement of the amount of food intake due to the mainly lack of nutritional information, which may include manual process of writing down this information, and other reasons. In worldwide 20% of deaths are caused by unnatural diets according to the World Health Organization (WHO). 39% of grown person with age 18 and over were over heavy in 2016 and 13% were obese. Maximum of the world's population survive in nations where death rate is high for over heavy and fatness rather than underweight. The main cause for fatness is the in proper consumption of food and energy yields. The BMI (Body Mass Index) will increase risk for diseases such as cardiovascular disorders, coronary heart disorders and many more. Persons with over 30 kg/m2 of BMI are typically seen for obesity.

Calorie is the nutritional unit for energy. Because of the chaotic life, health is the greatest requirement in the world. High-calorie intake can be dangerous and may result in numerous diseases. A calorie is the unit of energy. It indicates energy gained from eating and drinking, and also the energy burned through physical movement. For example, an apple contains eighty calories, from which about a hundred calories are utilized for a one-mile walk. Formally, a food calorie is the amount of energy that is required to increase the temperature of 1000 gram of water by 1 degree Celsius at a pressure of 1 atmosphere. The number of calories in food reveals us how much potential energy the food contains in it. The need to measure food calories is increasing day by day as people are more aware about consuming healthy meals to stay away from obesity.

Now-a-days obesity in adults is increasing at a shocking rate. The primary source of obesity is the disparity between the amount of meal intake and the energy burnt through physical activity. Breast, colon, and prostate cancers are caused due to high calorie intake. The existing calories measurement scheme is imperfect as there is manual entry of data such as food platter weight, food platter volume etc. To do this, we have developed a fully automated calorie measurement system.

We have used various ML modules in this system to evaluate the size of foodstuffs. Next, the user clicks on a photo of the food in a possible way (mainly in front, and top). These images are then taken by the

machine as input and the portion size and volume can be measured using CNN algorithms. Number of ML techniques can be used to perform this. However, after the image is given as an input, it is possible to define and segment simultaneously. The whole thing will be automated in this way and a final result will be derived from the whole summary of dietary items consisting of calories and other nutrients.

In order to provide information about nutrients in food to user, we have proposed this system. It will be useful to keep track and maintain the record of calorie and nutrients intake. Hence accurate estimation of food calorie is important in such cases.

II.   LITERATURE SURVEY ON RELATED WORK

Manal et al., proposed a machine learning based pipelined approach for predicting the calories from food images. The system takes an image of the food item and passes it through Math works Image Processing which extracts the raw features and improves the quality. The image is passed through a compression phase which helps to reduce the number of features using the Principal Component Analysis (PCA) method and scale the subsequent learning phases. The food type classification is done by inputting the compressed image to the classifier. The food size prediction is done by passing the compressed image to a regressor. Calories are predicted by passing the compressed image and predicted values to another regressor. This is based on supervised learning model [1]. Kohila et al., proposed a calorific value prediction mechanism using image processing and machine learning. The image of the food is transmitted through a mobile device and it initially undergoes image processing and final output is displayed. The mathematical morphology is utilized as a tool for extracting the image components and the region shape description such as erosion, dilation, opening and closing. Feature extraction is performed to retrieve interesting parts of the image and then calorie measurement is done [2]. Kiran et al., proposed a method for measuring the calories and nutrition from food images using machine learning techniques. The images got from the mobile device are pre-processed followed by the segmentation step to extract the colour and texture features through K Means clustering. The food portion volume measurement is done by superimposing a grid of squares onto the image segment which matches the irregular shape of the food images easily. The calorie measurement is done based on the food mass and nutritional tables. The system has limited cuisine varieties mixed food images have not been considered [3]. Chang et al., proposed a food image recognition for computer aided dietary assessment based on deep learning techniques. The proposed approach utilized two real-world food image datasets namely (UEC – 256 and Food – 101). The food image recognition is done by a new Convolutional Neural Network (CNN) method based on supervised learning algorithms. The CNN consisted of 3 convolutional layers, 2 sub sampling layers and a fully connected layer. The model was trained for a nonstop period of 2 to 3 days using a server with NVidia K40 GPU. After the training, the model classified the image in less than a minute. The proposed system lacked real-world data and the accuracy of the measurements have to be improve [4]. Yanchao et al., proposed a calorie estimation model based on deep learning approach which increases the detection accuracy and reduces the error of volume estimation. The image attainment is done by obtaining the food image using a smartphone. The object detection is done by using Faster Region based Convolutional Neural Networks (Faster R-CNN), which includes Region Proposal Network (RPN) and an Object Detection Network. Grab Cut, an image-based segmentation algorithm which depends on optimization by graph cuts is used for image segmentation. Volume Estimation requires calculation of side and top views scaling factor using equations based on the shape types. Finally, calorie estimation is obtained by using the volume and density value of the food mapped using ECUSTFD dataset [5]. Liang et al., proposed a "Calorie estimation method" which was designed for obese patients to check their food intake per day. This method is based on computer vision technique which requires the top and side view of food to estimate calorie from it. For the detection of food items, one yuan coin is taken as a calibration object. The Faster R-CNN algorithm is used and the contour of each food is detected using grab cut algorithm whereas the volume of food is estimated using volume estimation formulas and at last calories of each food are estimated as the output [6]. Podutwas et al. proposed a system named "food portion recognition system" which measures the calorie and nutrition values by taking the picture of food and then detect and classify the food portion using SVM. Segmentation and food portion recognition are performed using skull stripping and classification using SVM to calculate calorie and nutrients present in food [7].

III.   PROPOSED SYSTEM

In today's world the mobile devices users are increasing by day to day. Inventions in mobile devices are also powerful. These leads to increase the wireless world approach. Man is using mobile in every field. Mobile become a huge part of man's life. Health care apps are in high demand from people. In this system we try to make the app which is helpful for calculate the nutrition from food. Man has to upload one image of food into these app then by processing on that image our system gives nutritional value contained in that given food. Our system is useful to keep track and maintain the calorie and nutrients intake. An accurate estimation of daily nutritional intake provides a useful solution for keeping healthy.

In this section, we will review our system in more detail. We use Food-101 dataset which includes about 150 - 200 food images. Architecture of our system is given in figure1. The user will click the image of food and upload it in our system. That image is recognized by the algorithms of deep learning, after image identification the nutritional values are calculated and displayed to users.
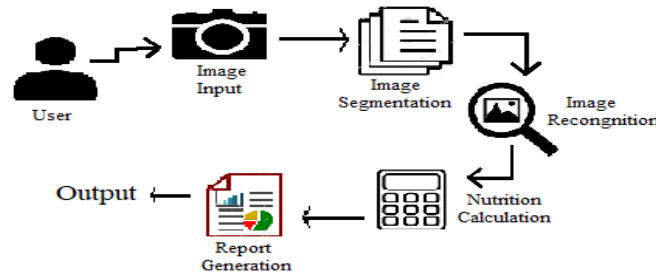

Fig.1 System Architecture

Implementation

A.   Image segmentation:

At first, the input image is mapped using many attributes like size of image, color of image, etc. By using deep learning CNN algorithm, the image is segmented. Firstly, Generation of Heatmap and class activation takes place, then image is gone through conv2D, batch_normalization, activation, max_pooling 2D layers, to properly map the image very deep segmentation have to be done. Faster R-CNN inception-v2 model Coco was used by Okan Alanet al., to detect objects. Here we give example of image segmentation of cupcake.
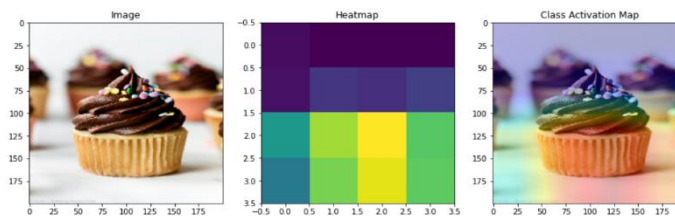

Fig. 2 Image segmentation of Cupcake

B.   Image Recognition:

In our system we train some food images using that trained data and the image which is mapped through image segmentation system recognize the image. If the input image is not found in that trained image, then system recognize that image using the shape of that image and segmented image. The algorithm does not gives accurately output in cases of blurred images. To get accurate output image should be in clear format.

C.   Nutrition Estimation:

Now, image is recognized properly then the calculation process takes place. Based on ingredients present and nutritional value present in that specific food total nutrition is calculated. Based on our concept, the total nutrition in food, is assumed as a summation of nutrition present in all ingredients. We refer database to get the nutrition value of food items. It gives all the data of nutrition present into specific food. Here we have given one table to get the idea about nutrition present into the food.

French Fries		Cup Cake	
Sugar	0.3 g	Protein	4.3 g
Protein	3.4 g	Potassium	224 mg
Sodium	210 mg	Caffein	2 mg
Fats	15 g	Fats	3.7 g

Table 1. Nutrition table

D.   Report Generation:

Further task is to generate the report of nutrition, estimated by system and present them in graphical format. Report is presented in percentage format. To give information about different types of nutrition present in that food we used pie chart to display the nutrients. It gives proper idea about nutritional value in food items. We also provide one extra feature to give extra information about food present into input image. Here we

provide one link to get the extra information about nutrition in food. Here we give one example of nutrition estimated from French fries' image:
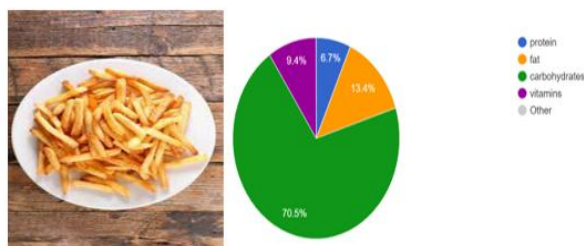

Fig. 3 Nutrition estimated in French fries

IV.   RESULT AND OBSERVATION

The sample dataset is contained with images of fruits along with their actual calories value. Result also shows the probabilities of food matching with another shape of food items. The graph below shows actual and predicted values of protein for different food items.
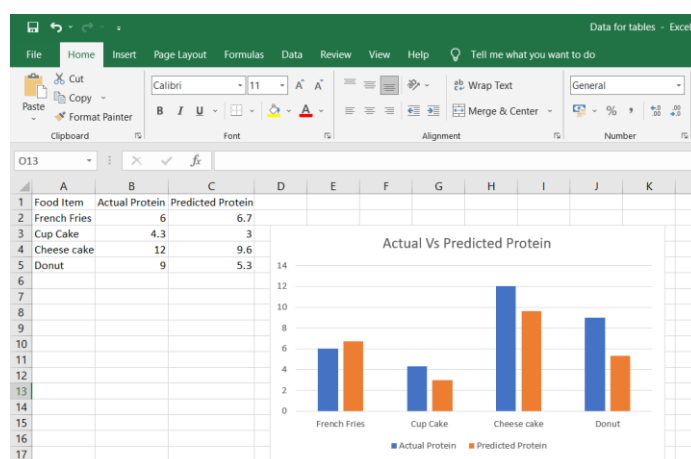

Fig. 4 Graph of actual protein and trained protein

V.   CONCLUSION

Our projects offer a nutrients calculation using algorithms for machine learning. With machine learning and image processing we measured the nutrients in the food items. In this the image is recognized by using the deep learning algorithms, after image segmentation the estimation of nutrients in the food is done. At the end we generate a report of nutrition, estimated by system in the graphical format. We also provide one extra feature to display A ingredients present in food item and each ingredients contain which nutrients. For this purpose, we provide one link for get extra information. This method would be helpful for all peoples to maintain their healthy diet plan. The convolutional neural network is used to solve each task, which proves that the experimental results of food dataset play a certain role in improving the recognition accuracy. Then, because the measurement method needs to collect a large number of training samples for display, so the image matching method is used to identify, and the dataset with less samples is constructed.

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