"Image Based Classification of Food for Proper Calorie Estimation"

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Abstract:

Obesity is growing globally and is a danger issue for many chronic situations such as heart disease, sleep apnea, type-2 diabetes, and some cancers. The project consists of two steps: identifying food from an image and converting the food identification into calorie estimation. Overweight is defined as irregular or extreme fat accumulation that may damage health. Research shows that the food logging is beneficial in promoting weight loss. Crowdsourcing has also been used in promoting dietary feedback for food logging. This paper examines the feasibility of crowdsourcing to provide support in accurately determining calories in meal images.

***Keywords*:** Food image, classification, recipes (ingredient).

I. Introduction:

In the recent studies, a lot of data is generated which is required to be utilized and analyzed. So, we developed a system which is useful in predicting the user's health situation depending on the user's food intake. Obesity is increasing worldwide and it leads to some critical cancers. Research shows that food logging is beneficial in promoting weight loss. Crowdsourcing is used to promote dietary feedback for food logging. This work investigates the feasibility of crowdsourcing to approximately predict the calories in the meal images. The system is completed by a calorie estimation survey consisting of meal images. The objectives were,

1) To determine if a crowd of experts and non-experts can approximately estimate the calorie content in images of meals,

2) To determine if analyzing group of non-experts calorie estimation can be used to adjust calorie content in images of meals to promote accuracy. The conclusion of this paper was as follows: related work will be discussed to determine what methods and technologies have been used previously, methodology section will be discussed detailing the processes in this work, a section detailing results of the experiments, discussion section examining the results, study limitations, and key conclusions.

II. Related Work:

Crowdsourcing uses 'understanding of the troops' to allow a group of people to complete an activity to reach a goal or to solve a problem. Crowdsourcing was used to control the food type, food size, and calorie by using Amazon Mechanical Turk. In this, tasks were repeatedly completed by workers using the platform to provide a nutritional workflow. Results from these tests indicate that using crowdsourcing to determine the nutritional value of meals is nearly as accurate as trained dieticians. Crowdsourcing was also used for dietary rating of food images. For robustness, the scale was used so that registered user can rate each image and results shows there was a high association between user scores and specifies that crowdsourcing can be used for dietary feedback. Similar research used a traffic light diet approach to assess the nutritious quality of images.

III Methodology

The work defined had a daily plan of two set of tests (1) calculate expressive numerical examination (2) calorie alteration procedure. The first tests were finished to analyze the presentation of non-experts and experts responses collected from a calorie estimation survey and determine the relationship between each group and meal images. Accuracy results will be compared with ground truth calories of each meal image to measure presentation of the revolution process.

1.1 Participants & Recruitment: -

Participants were invited to complete a calorie estimation survey. Participants were divided into two groups; experts and non-experts, experts were individuals who have knowledge of dietetics and nutrition, and nonexperts individuals who have no trained knowledge of nutrition. Non-experts consisted of students within Ulster University and individuals not affiliated with Ulster University. Experts were recruited from the nutrition and dietetic staff from Ulster University. Convenience sampling was used (experts n=22 and non-experts n=120).

1.2 Online Survey & Food Images:-

The connected survey contained 15 photographs of meals taken by an investigator, who is also a trained dietician. The 15 meals will include 5 breakfasts, 5 lunches, and 5 dinners. The photos were taken on a smartphone device (iPhone 5). To calculate the calories of the food items in each image, each meal was weighed, and food labels and food tables were used. Members completing the survey were asked the following question for each meal image from viewing the photograph, like "enter the number of calories you consider is in this meal? Kcal OR KJ". To complete the survey, participants are asked to input their estimated calories for each meal image as well as confidence levels. In this work, calorie approximations were only used for examination.

IV Motivation:

It is found that weight gain is a serious health problem now a day which leads to a disease such as obesity, diabetes. To avoid weight gain, food journaling acts as an effective tool but existing diet

application is too slow and difficult for patient use. Therefore we had proposed this paper calorie estimation on food. We have compensated this increase of diseases by recommending a perfect diet for the users, but it depends on which type of food user is taking.

System Architecture:

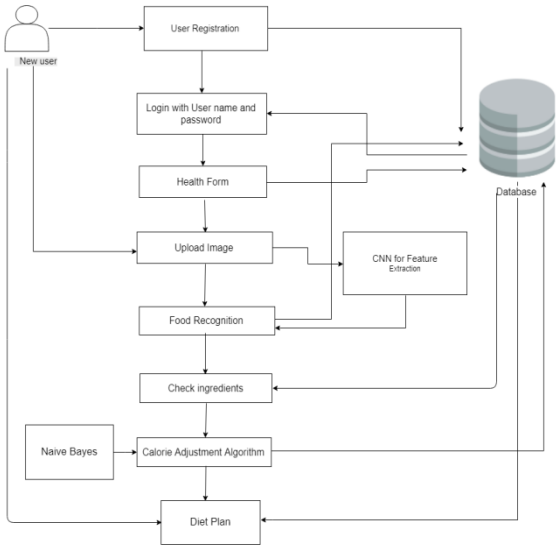

Fig: system overview

The new user needs to register and login to upload a food image. Post image calculations of the ingredients will be done to understand the number of calories present in the food and according to that we will classify the diet and recommend the diet plan for the user.

Algorithm Used:-

1) CNN

CNN- CNN has become a state-of-the-art solution for large-scale object classification and object detection tasks. In this project, Naïve Bayes is used to classifying the Calories. And CNN (convolutional Neural Network) algorithm is used to extract the features from the images.

Steps in CNN:-

1. Convolution Layer- In this layer, we apply a filter (3*3) for the image.
2. Pooling layer- Pooling is an important component of convolutional neural networks for object detection. Convolutional networks may include local or global pooling layers which combine the outputs of neuron clusters at one layer into a single neuron in the next layer.
3. Fully Connected layer- Neurons in a fully connected layer have full connections to all activations in the previous layer, as seen in regular Neural Networks. Their activations can hence be computed with a matrix multiplication followed by a bias offset.

A CNN consists of an input and an output layer, as well as multiple hidden layers. The hidden layers of a CNN typically consist of the convolutional layer, pooling layer, fully connected layer Convolutional layers apply a convolution operation to the input, passing the result to the next layer.

2) Naive Bayes:-

In the Naïve Bayes classifier, we predicate the result, depending upon the training dataset. Naive Bayes classifier assumes that the presence of a particular feature in a class is unrelated to the presence of any other feature. For example, a fruit may be considered to be an apple if it is red, round, and about 3 inches in diameter.

Even if these features depend on each other or upon the existence of the other features, all of these properties independently contribute to the probability that this fruit is an apple and that is why it is known as 'Naive'. Naive Bayes model is easy to build and particularly useful for very large data sets. Along with simplicity. Naive Bayes is known to outperform even highly sophisticated classification methods.

V Mathematical Model

S = {s, e, X, Y, F, A}

S= Set Theory

s = Start of the program

1. Register/Login into the system

e = End of the program

X = input of the program=Food image

Y = Output of program = Calorie Estimate

A=Success of program=

1. Image predication
2. Calorie estimate
3. Recommend diet plan

F = Failure of Program= Prediction Failure

First, user provide food image.
System extracts features with the help of Convolutional neural network.
Let F be the set of features
F= {F1, F2, ..., Fn}
These features are compared with extracted features of training dataset images. The classifier classifies these features and determines whether the given food is sufficient or not and if it is insufficient then we have to recommend the diet plan.
These features are mapped into feature space with n dimensions. Distances from all mapped objects are calculated by using distance formula as given below,
$D= Sq.rt((F_{11}-F_{12})^2+(F_{21}-F_{22})^2+...+(F_{n1}-F_{n2})^2)$
Fixed n number of objects is then extracted. Label for each object is then checked. The label with highest count among nearest neighbours is then provide the prediction.

Time Complexity of CNN = back propagation, O (n^5) O (n5), is much slower than the forward propagation, O (n^4) O (n4).

Space Complexity of CNN= O(n 2) where m is the training set size

VI Conclusion:-

The system considers the generalized calorie intake of an individual depending upon experts and feedback from non-experts to decide whether the food is healthy or unhealthy.

Every human body requires a specific amount of vitamins, calories, carbohydrates, etc. If these things get imbalanced then these will result in a health problem. Hence to keep a person away from diseases caused by inadequate consumption of calories we proposed the system. This system will estimate the calories of a particular person by considering their BMI. Further, this system would generate a diet plan.

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