Food Recognition and Classification Using SVM

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Abstract: ***Today people are more concerned about their daily calorie intake, as it creates several positive or negative impacts on the health based on its proportion. An unbalanced diet may cause many problems like weight gain, obesity, diabetes, high cholesterol, and heart attack. Even though the people can record their meal and discuss it with doctors or experts, it is not so convenient and they cannot know the number of calories before the meal.***

This paper presents an effective way to measure and manage the daily food intake of the user. From the input food images, the users can understand the amount of calories they will take in each meal by using the Support Vector Machine (SVM) algorithm. The system uses several features like FCTH and CEDD that deals with the extraction of a new low level feature that combines, in one histogram, color and texture information. This features FCTH - Fuzzy Color and Texture Histogram and CEDD - Color and Edge Directivity Descriptor. This features helps for appropriate retrieving images even in distortion cases to classify the food images. Based on the calorie count system recommend the user to keep body profile like fitness, reduce weigh or increase weight.

Keywords: Food Classification, Calorie Calculation, Calorie Consumption, Daily Intake, Support Vector Machine (SVM), Image Processing, Breakfast, Lunch, Dinner.

I. INTRODUCTION

A daily diet is very necessary for day to day life. The food gives nutrition to our bodies to provide information to function properly. If we will not get the precise data our metabolic progressions grieve and our fitness decays which cause various health issues. An unbalanced diet may cause many problems like weight gain, obesity, diabetes [1] [7] so it is necessary to manage our daily food intake.

Calorie and Nutrition measurements are used to monitor body fat as they generate energy. But if taken in the excess quantity it gets stored in the form of fats, thus making us overweight. Every age group may differ calorie requirements from that of a child to an adult. Detection of food item from the image is a key process in calorie measurement systems.

Food recognition or classification is a challenging task as there are a large number of intra-class variations in the food items. Same food can have multiple visual appearances that make it more complicated for its recognition and estimate calorie from a given image of the food item. The dietary assessment system gives an efficient way for a person's food intake.

The users who lack knowledge about nutrition might be unable to know the number of calories in each meal. Although they can ask experts to identify the number of calories, it is not convenient a way or always feasible to know the calories there and then. Here efforts are made to implement a system that can help to detect the number of calories in each of the food items consumed at different times like breakfast, lunch and dinner using image processing techniques. The system detects the type of food using a Support Vector Machine classifier and recommends the fitness diet from the calorie dataset.

II. RELATED WORK

Ankita A. Podutwar et al.[1] provides a Food Recognition System for Calorie Measurement. Here users just take a picture of the food image then recognize the image to detect the type of food portion and classify using a support vector machine. Segmentation, food portion recognition using skull stripping and classification using support vector machine are used to calculate the calorie along with the type of energy inaccurate way.

Natta Tammachat et al.[2] presents a technique of image processing to recognize images of Thai food taken by users. From the input food images, the users can understand the number of calories they will take in each meal by using the proposed algorithm. This method creates feature vector using several features about texture and color, then classify the food images using SVM. The system can detect the food type and the number of calories.

S. Jasmine Minja et al.[3] presents a dietary management system that calculates the calorie value of every food item. FCM algorithm is used here for segmentation and Sphere Shaped SVM classifier is used to classify the segmented food items. This method automatically identifies the food items with 95% accuracy and then calculates their calorie value.

An effort has been taken by David Joseph Attokaren et al. in [4] to classify the images of food for further diet monitoring applications using convolutional neural networks (CNNs). Since the CNNs are capable of handling a large amount of data and can estimate the features automatically, they have been utilized for the task of food classification. The standard Food-101 dataset has been selected as the working database for this approach.

Anita Chaudhari et al.[5] develop an application for estimating nutrition calories and improve people's consumption conducts for health-care using CNN, which runs on mobile devices. A Fruit image dataset is used for capturing multiple images of a particular fruit, applied Convolutional Neural Network to the identification of 20 fruit objects, and calculated its presentation. After recognition, the algorithm fetches the nutrition values of the detected object and display it to the user.

Giovanni et al.[6] addresses the study of food image processing from the perspective of Computer Vision. The author used the texture-based representation of food images and introduce new dataset UNICT-FD1200d for the study of food image representation.

Parisa Pouladzadeh et al.[7] introduce FooDD: a Food Detection Dataset of 3000 images that offer a variety of food photos taken from different cameras with different illuminations. Graph cut segmentation and deep learning algorithms are used for food detection. A dataset comprising 3000 food images is used for the classification of the food. Good distribution of single and mixed food images is one of the strong features of the given dataset.

III. PROPOSED SYSTEM

The main aim of this paper is to present a system that detect the type of food by capturing an image and provides total calorie content of that food using calorie content database. Figure 1 gives the architecture of the proposed system followed by the detail working of the system.

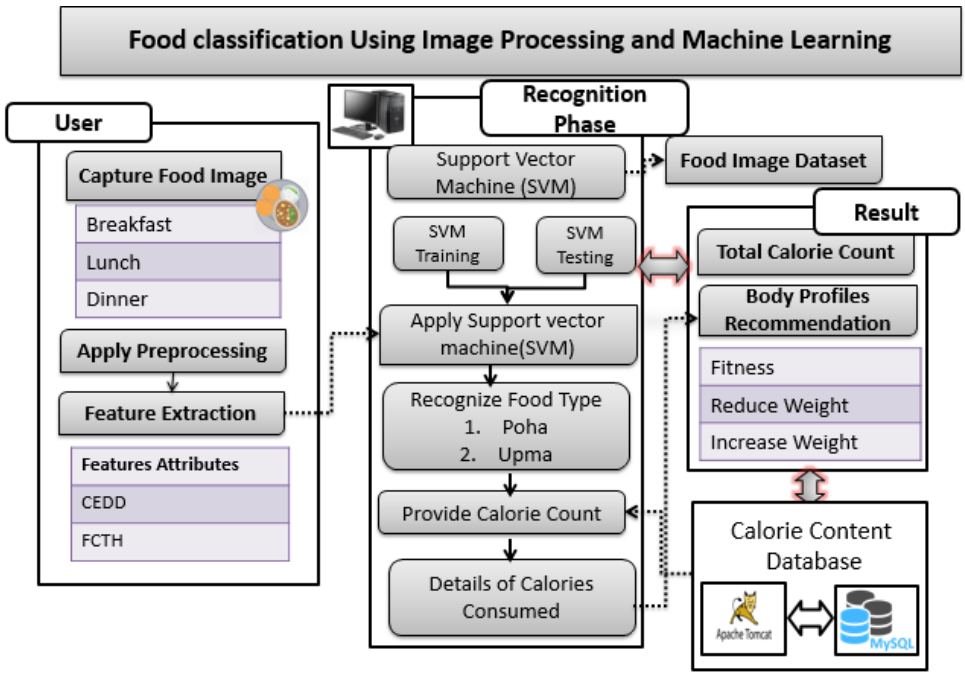

Figure 1: System Architecture

1. Capture Food Image

The main aim of the proposed system is to measure and manage the daily calorie intake of the user as it has a great effect on the health of the user. Ideally, a person should have energy consumption in the following meals:

- Breakfast: 20% (a fifth of your energy intake)
- Lunch: 30% (about a third of your energy intake)
- Evening Meal: 30% (about a third of your energy intake)
- Drinks and Snacks: 20% (a fifth of your energy intake)

So to calculate the calorie contents from the food, the user needs to take the food image first. Users should be able to search for a food item and take different types of food images to find out their calorie content.

2. Preprocessing:

The Captured food image may contain a lot of noise. By using noise removal techniques or removing any other disturbances present in the data, it is preprocessed to get the fine-tuned image.

In this phase, the system preprocesses the input image. It checks the image quality, size etc. Also, it resize the input image into fixed dimensions i.e. 128 X 128.

3. Feature Extraction:

From the preprocessed input image system can extract the features that are as follows,

1. CEDD (Color and Edge Directivity Descriptor)
2. FCTH (Fuzzy Color and Texture Histogram)

These features are deals with the extraction of a new low-level feature that combines, in one histogram, color and texture information. This feature helps for appropriate retrieving images even in distortion cases to classify the food images.

4. Classification:

Once the features are extracted and normalized, we train a Support Vector Machine model for Food Image for food type recognition. The system detects the food type like poha, upma or idli using the SVM algorithm and calorie count for that particular food is given using the calorie content database.

5. Diet Suggestion

The system provides details of calories consumed by the particular food and based on that it recommends different body profiles like if the user is fit, needs to reduce weight or increase weight. Food and calorie content are shown in the database.

IV. ALGORITHM USED

- SVM is a powerful classifier that is able to distinguish two classes. SVM classifies the test image in to the class with highest distance up to the neighboring point in the training.
- SVM training algorithm builds a model that predict whether the test image fall into this class or another.
- SVM necessitate a vast training data to decide a decision boundary and computing cost is very high although we are using single pose (frontal) detection.
- The SVM is a learning algorithm for classification which attempt to discover the finest distinguishing hyper plane which minimize the error for unseen patterns.

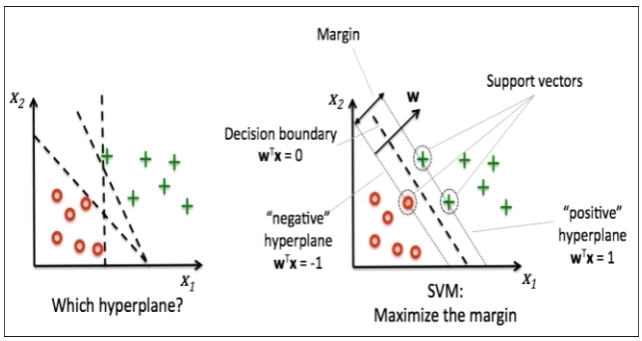

Figure 2: Distinguishing Hyper Plane to Minimize the Error

- The data which cannot be distinguished the input is mapped to high-dimensional attribute space where they can be separated by a hyper plane. This projection is well performed by means of kernels.

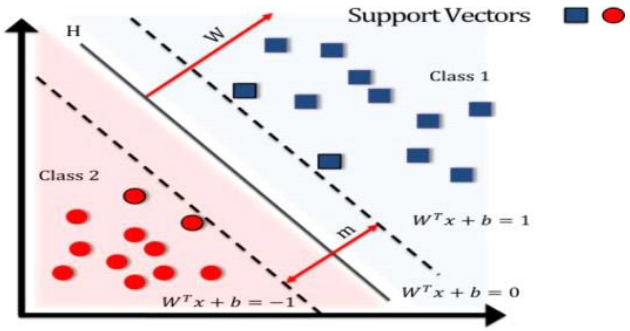

Figure 3: Separating Hyper Plane by Equation

- If training set of samples and the equivalent resultant values {-1, 1}. So SVM intend to get the best separating hyper plane specified by the equation W^Tx+b that make use of the distance between the two classes as shown in above figure 3.

V. EXPERIMRNTAL RESULTS

The dataset consists of 8 food items. The SVM classifier is trained on these Indian cuisines and we obtained an accuracy of 90.5%.

Below is the table of food items used for classification:

TABLE 1: List of food items

Sr. No.	Food Item	No. of images
1.	Apple	75
2.	Banana	75
3.	Dosa	75
4.	Idli	75
5.	Palak Paneer	75
6.	Paneer Tikka	75
7.	Poha	75
8.	Sabudana Khichdi	75

Figure 4: Indian Cuisines in the Dataset

Class	Precision	Recall	F1-score
Apple	**1.0**	**1.0**	**1.0**
Banana	**1.0**	**1.0**	**1.0**
Dosa	**0.88**	**0.75**	**0.81**
Idli	**0.75**	**0.82**	**0.78**
Palak Paneer	**0.92**	**1.00**	**0.96**
Paneer Tikka	**0.91**	**0.91**	**0.91**
Poha	**0.91**	**0.87**	**0.89**
Sabudana Khichdi	**0.71**	**0.75**	**0.73**

TABLE 2: Precision, Recall and f1 Score Table

The precision obtained for the classes Apple, Banana, Dosa, Idli, Palak Paneer, Paneer Tikka, Poha and Sabudana Khichdi above is given in the **TABLE 2**.

VI. CONCLUSION

Food detection, classification, and analysis have been the topic of in-depth studies for a variety of applications related to eating habits and dietary assessment.

This system presents an effective way to measure and manage the daily food intake of the user using machine learning techniques. For that user first, take the image of the food and then by using the FCTH and CEDD feature we can detect the type of food using the support vector machine. The system also provides the calorie count of the captured food item. The system provides details of calories consumed by the particular food and based on that it recommends different body profiles like if the user is fit, needs to reduce weight or increase weight.

References

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