



International Journal of Advance Engineering and Research Development

Special Issue on Recent Trends in Data Engineering

Volume 4, Special Issue 5, Dec.-2017

RECIPE RETRIEVAL USING INGREDIENT RECOGNITION

¹Prof. M.P Nerkar, ²Preety Vajpayee, ³Varsha Ganjoo, ⁴Vaibhav Suryawanshi, ⁵Pooja Sonawane .

^{1,2,3,4,5}Department Of Computer Science, AISSMS IOIT

Abstract — Based on the generic object recognition, we propose a cooking recipe recommendation system on an android smart phone which includes food (vegetable and meats) detection involving object recognition. The system which we have proposed gives the real time recognition of the food stuff and using with a recommendation system, helps retrieve recipes including those food ingredients. When the user points a smart phone camera towards the food items, the recipes are retrieved instantly based on certain ranking. The design and implementation of the system is such a way that it can be used intuitively and effectively at grocery shops as well as at homes.

Keywords-Generic object recognition; Recommendation system; Android; Food ingredients; Ranking; Recipes.

I. INTRODUCTION

With time the food recipe sites such as cooks.com and BBC food search have gained popularity in the common masses. When in need of a cooking recipe to prepare, people rush to these sites to access the recipe they like or wish to get ready. Since, the sites as mentioned above can be used on mobile phones and PCs as well so one can have their admittance. But the problem resides with the textual input to these sites or giving the keywords for the menu preferences. When some unidentified food item is witnessed by the user then with these issues user faces the problem of referring the cooking recipes from the menu.

Today, the progressed skills encounter the name of object recognition technology. Especially, generic object recognition, based on which the things present in the picture are categorized as the ones recognized have flourished to much extent. In addition, real time image recognition has become possible with the advent of features in smart phones. Based on the generic object recognition, we propose a cooking recipe recommendation system on an android smart phone which includes food (vegetable and meats) detection involving object recognition.

The system which we have proposed gives the real time recognition of the food stuff and using with a recommendation system, helps retrieve recipes including those food ingredients. When the user points a smart phone camera towards the food items, the recipes are retrieved instantly based on certain ranking. The design and implementation of the system is such a way that it can be used intuitively and effectively at grocery shops as well as at homes.

In the recipe recommendation part, the recipes involving only the recognized ingredient will be retrieved first at the top and the ones which need more ingredients to be added will come next. This will be one type of classification employed, apart from this the topmost recipes will again be classified based on the time required for cooking.

II. MOTIVATION

Some of the problems have been inspected in the food image recognition, recipe retrieval and menu recipes classification. Widely studied surveys which possess these problems delve into the developing of the binary correlations between visual substance, textual content, and elements.

1. The food images present on web are mostly unstructured data which makes the recipe retrieval difficult if the image training data set is having those images.
2. It is hard to retrieve high-level recipe names from the low-level substance.
- 3.

III. PROPOSED SYSTEM ARCHITECTURE

The proposed system architecture will work as per the steps provided. These steps are :

1. The camera used will be general smart phone camera.
Pixel quality- even a basic 5MP is sufficient.
Ingredient availability and the ingredient should be recognized by the camera.
2. The captured food ingredients will be recognized based on the hue, saturation and brightness.
The feature extraction will be done by HAAR – color, texture and geometrical features.
The images will get matched with the image dataset that will be created manually.
Finally the image will be recognized.

3. Using data classification algorithm- KNN the recipes including the ingredients will be retrieved from the database whose content will be procured from Food.com.
4. In the recipe recommendation part, the recipes involving only the recognized ingredient will be retrieved first at the top and the ones which need more ingredients to be added will come next. This will be one type of classification employed, apart from this the topmost recipes will again be classified based on the time required for cooking.

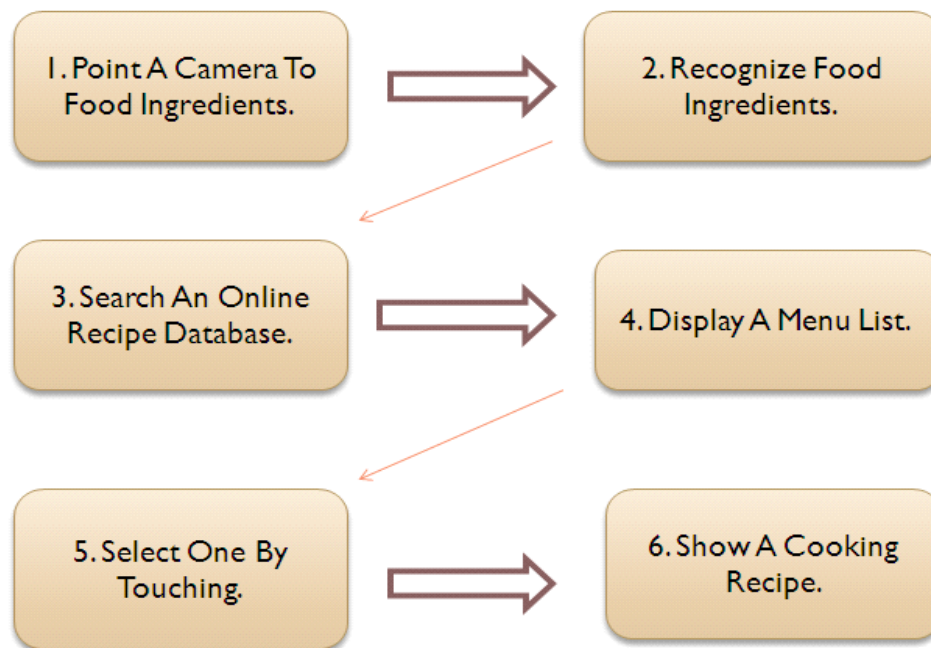


Figure 1. Proposed system architecture

3.1. Algorithms used

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|---|--|
| 1. Feature extraction : HAAR like feature | chosen from : LBN, HAAR, SIFT. |
| 2. Data classification : kNN | chosen from : C45, Naïve Bayes, kNN. |
| 3. Image classification : SVM | chosen from : mRMR, Genetic algorithm, SVM adaboost. |

3.1.1. Feature extraction (HAAR like feature)

The idea of using HAAR wavelets was adapted by Viola and Jones and thus came up with the development of the so-called HAAR-like features- color, texture and geometrical features. A HAAR-like feature considers the specific location which boundaries the adjacent rectangular regions in the detection window, then the pixel intensities of these regions are summed and the difference between these sums is calculated. The subsections of the figure are labeled using these alterations. For example, consider an image database with individual faces. It is a commonly observed that the areas around the cheek are lighter and the area around eyes is darker. Thus, a set of reclined two neighboring rectangles above eye and cheek section forms a general HAAR trait for face finding. A detection window which acts as a bounding box to the target object (here face), defines the relative position of these rectangles.

A window of the target size is moved over the input image in the detection phase, and for each image the colour, texture and geometrical features are measured.

Advantages:

The computation rate makes HAAR-like feature a plus point over most of the other traits. The HAAR-like traits for any depicted size can be computed in constant time by using the integral images.

1. It is conceptually not complex.
2. It is executed fast.
3. Since, it can be computed in place without an impermanent array so is memory proficient.
4. It can be reversed easily without the edge effects which otherwise is a problem with other Wavelet transforms.

Limitations:

1. The HAAR transform performs an average and difference on a pair of values for generating each of averages for the next level and each set of coefficients,.
2. To calculate another average and difference on the next pair, the algorithm has to shift over by two values.
3. All high frequency changes should be depicted by the high frequency coefficient spectrum.
4. The HAAR window is widened for only two elements which can not reflect a big change which takes place from an even value to an odd value, in the high frequency coefficients.

3.1.2 Image classification (SVM)

Support Vector Machine (SVM) is an administered machine learning algorithm. It can be utilized for both arrangement and regression confronts. Mostly it is used in classification troubles. Each data item in this algorithm is plotted as a point in n-dimensional space (where n is number of features you have) with the value of a particular coordinate giving the value of each feature. Then, by finding the hyper-plane that differentiates the two classes very well, classification is performed.

Advantages :

1. With the clear margin of separation this algorithm works really well.
2. Effective utilization of high dimensional spaces.
3. When the number of dimensions is greater than the number of samples, this case effectually uses SVM.
4. By using the subset of training points in the decision function (called support vectors), it appears as memory efficient.

Limitations :

1. When provided with large data sets, it doesn't perform well because the required training time is higher.
2. It also doesn't perform very well, when the data set has more noise i.e. target classes are overlapping.
3. As the probability estimates are calculated using an expensive five-fold cross-validation thus are not given directly.

3.1.3 Data classification (kNN)

kNN (k- nearest neighbor) is the algorithm used for classifying the data. It uses the Nearest-neighbour classifiers which are based on learning by analogy, that is, by comparing a given test tuple with training tuples that are similar to it. The training tuples are described by n attributes. When $k = 1$, the unidentified tuple is allocated the class of the training tuple that is nearby to it in pattern space.

Advantages :

1. Data from any distribution can be addressed for example, data does not have to be separable with a linear boundary.
2. Very clear and intuitive.
3. If the number of samples provided is large enough, good classification is achieved.

Limitations :

1. It is a tricky task to choose variable k.
2. The computation used in test cases is expensive.
3. All the work is done during the test stage as it lacks training stage.
4. Need large number of samples for accuracy.

IV. PRODUCT ANALYSIS

For the product analysis we compared the traditional websites and the proposed system on the basis of certain values.

Table 1. Analysis of recipe related products

Features	Old Models	Proposed Application
Input	1) Words as recipe required as in yumly.com 2) Words as the ingredients present as in cooks.com	Input given will be images of the ingredients.

Output	Recipe in particular	Ranked recipes based on the ingredients recognized at top with internal ranking based on time required and additional ingredients if required.
Convenience	Web sites - not more convenient.	Android Application- It is convenient to user anytime and anywhere.
Classification	No classification based on ingredients.	Classification based on ingredients and time required for cooking.
Availability	Not real time	Real time usable; can be used in grocery stores with real time ingredients.

V. LITERATURE SURVEY

Table 2. Review of papers surveyed

Title	Journal Year	Extract	Advantages	Limitations
[1]Real-time Mobile Recipe recommendation System Using Food Ingredient Recognition	ICMEW, 2013 IEEE International Conference	Using food ingredients as object for recognition for recipe retrieval.	1. Classification rate of 83.93% . 2. System works efficiently in case that food ingredient recognition works.	Using other image features and food ingredient regions from background regions.
[2]Recipe recognition with large multimodal food dataset	ICMEW, 2015 IEEE International Conference .	1. Automatic systems for image recipe recognition. 2. Using visual, textual information and fusion it present deep experiment of recipe recognition on the database.	Database with large multiple food categories.	It directly depends on specific application, whether the images should be considered as error or not.
[3] Real-time Mobile Food Recognition System	IEEE 2013	Mobile recipe recognition system for maintaining approximation nutritional values of foods and maintaining a user's eating routine.	The system does not need to send images to a server and runs on an ordinary smart phone in a real-time way.	The system begins food recognition within the drawn bounding boxes by discovering food stuffs, a user uses bounding boxes
[4] Food Cam: A Real-Time Mobile FoodRecognition System Employing Fisher Vector	Springer International Publishing Switzerland 2014	With Fisher Vector which enable us to record our food habits easily. We demonstrate a mobile food	An interactive and real-time food recognition and recording system running on a consumer smart phone, using Fisher	Non recognition of images due to reflectance and blurring images .

		recognition system.	Vector on a mobile device , automatic adjustment of the given bounding box.	
[6]Deep-based Ingredient Recognition for Cooking Recipe Retrieval	2016 ACM.	This paper briefs about the feasibility of ingredient recognition and works on the zero-shot problem cooking recipe retrieval.	Better performance than directly inferring ingredients from recipes searched by VGG. When further using the predicted ingredients for matching recipes of unknown food categories .	Multi-task model could not deal with ingredients (e.g., honey, soybean oil) that are not observable or visible from dishes.

VI. CONCLUSION

In this paper, we advent a cooking recipe retrieval with the recognition of food ingredients using the mobile device, which helps us to search for cooking recipes once a built-in camera is pointed to food ingredients and that too instantly. For future work, the plan is to improve the object recognition, recipe recommendation and the system user interface. With respect to the object recognition, we would like to attain 95% or maximum classification rate within the food ingredients by adding more and more features of the image and segregating background regions from the regions occupied by the food ingredients. For the recipe recommendation, we plan to put into practice the recipe search considering multiple food ingredients combined as one, along with their nutrition and the budgets. For now, the recipes are classified on the basis that the recipe involving recognized ingredient will be put on top and the ones including addition of ingredients at the bottom of the menu list. Moreover, the top rated recipes will again be classified based on the time required for the recipe to cook i.e. less time as usually preferred on top and rest accordingly in ascending order of preparation time. Note that the application is for Android smart phones.