[DEMO PAPER] MIRURECIPE: A MOBILE COOKING RECIPE RECOMMENDATION SYSTEM WITH FOOD INGREDIENT RECOGNITION

Yoshiyuki Kawano, Takanori Sato, Takuma Maruyama and Keiji Yanai

Department of Informatics, The University of Electro-Communications, Tokyo
1-5-1 Chofugaoka, Chofu-shi, Tokyo, 182-8585 Japan
{kawano-t,sato-ta,maruya-t,yanai}@mm.inf.uec.ac.jp

ABSTRACT

In this demo, we demonstrate a cooking recipe recommendation system which runs on a consumer smartphone. The proposed system carries out object recognition on food ingredients in a real-time way, and recommends cooking recipes related to the recognized food ingredients. By only pointing a built-in camera on a mobile device to food ingredients, the user can obtain a recipe list instantly. The objective of the proposed system is to assist people who cook to decide a cooking recipe at grocery stores or at a kitchen. In the current implementation, the system can recognize 30 kinds of food ingredient in 0.15 seconds, and it achieved the 83.93% recognition rate within the top six candidates.

Fig. 1: Using the proposed system at a grocery store. A user points a mobile phone camera to food ingredients on a display stand, and then the system advises cooking recipes based on the recognized ingredients instantly.

1. INTRODUCTION

Recently, cooking recipe sites such as cooks.com and BBC food search has become popular. Some of the people who cook use such sites to obtain information on cooking recipes. Since these sites are accessible from mobile phones as well as PCs, a user can access these sites at a grocery store as well as at home. However, to use these sites, a user has to input some keywords or select menu items to indicate his/her preferences on cooking menus. This may cause to prevent users from referring cooking recipe sites during shopping at grocery stores.

On the other hand, object recognition technology has been made much progress so far. Especially, generic object recognition, which is the technology that categories of the objects shown in an given image are recognized, have achieved tremendous progress. In addition, due to recent progress of smartphones, object recognition on smartphones in a real-time way becomes possible.

Based on these situations, in this demo paper, we propose a cooking recipe recommendation system on a mobile device employing object recognition for food ingredients such as vegetables and meats. The proposed system carries out object recognition on food ingredients in a real-time way on Android-based smartphones, and recommends cooking recipes related to the recognized food ingredients. By pointing a mobile phone camera toward food ingredients, a user can receive a recommendation recipe list instantly. We designed and implemented the system to be used easily and intuitively during shopping at grocery stores or supermarkets as well as before cooking at home as shown in Figure 1.

To speed up object recognition for enabling the system to recommend cooking recipes in a real-time way, the system uses bag-of-features with SURF and color-histogram extracted from multiple frames as image representation and linear kernel SVM as a classifier. We built 30 kinds of food ingredient short video database for the experiments. With this database, we achieved the 83.93% recognition rate within the top six candidates.

2. PROPOSED SYSTEM

2.1. Overview

The objective of this work is to propose a mobile system which assists a user to decide what and how to cook using generic object recognition technology. We assume that the proposed system works on a smartphone which has built-in cameras and Internet connection such as Android smartphones and iPhones. We intend a user to use our system easily and intuitively during shopping at grocery stores or supermarkets as well as before cooking at home. By pointing food ingredients with a mobile phone built-in camera, a user can receive a recipe list which the system obtained from online cooking recipe databases instantly. With our system, a user can get to know the cooking recipes related to various kinds of food ingredients unexpectedly found in a grocery store including unfamiliar ones and bargain ones on the spot.

To do that, the system recognizes food ingredients in the photos taken by built-in cameras, and search online cooking recipe databases for the recipes which need the recognized food ingredients.

As an object recognition method, we adopt bag-of-features with SURF and color histogram extracted from not single but multiple images as image features and linear kernel SVM with the one-vs-rest strategy as a classifier.

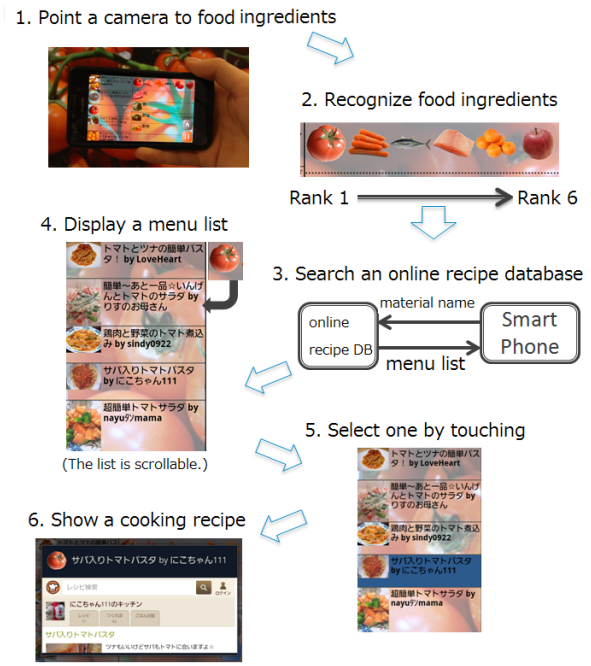

Fig. 2: Processing flow.

2.2. Processing Flow

As mentioned before, our system aims to search for cooking recipes during shopping at grocery stores. In this subsection, we describe the flow of how to use the proposed system from taking photos of food ingredients until watching the recipe pages a user selected. Figure 2 shows the flow.

Step 1 Point a smartphone camera toward food ingredients at a grocery store or at a kitchen. The system is continuously acquiring frame images from the camera device in the background.

Step 2 Recognize food ingredients in the acquired frame images continuously. The top six candidates are shown on the top-right side of the screen of the mobile device.

Step 3 Search online cooking recipe databases with the name of the recognized food ingredient as a search keyword, and retrieve a menu list. If a user like to search for recipes related to other candidates than the top one, the user can select one of the top six ingredients by touching the screen.

Step 4 Display the obtained menu list on the left side.

Step 5 Select one menu from the menu list. A user can see other menus than ones shown on the screen initially by scrolling.

Step 6 For the selected menu, display the corresponding cooking recipe including a list on necessary ingredients and seasonings and a cooking procedure on the pop-up window. Basically, the recipe page in the original recipe site will be shown.

Typically, an user uses the proposed system according to the above steps from one to six. Figure 3 shows the system screen.

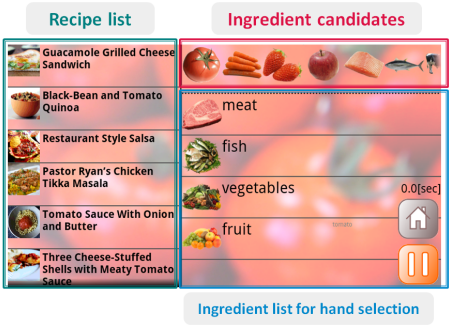

Fig. 3: The system screen.

2.3. Search Online Cooking Recipe Databases

Instead of preparing our own cooking recipe database, we use Web APIs of commercial cooking recipe sites on the Web such as CookPad and RecipePuppy. CookPad is a Japanese food recipe site where all the information is written in Japanese language, while RecipePuppy mainly focuses on Western food recipes which is operated by a US company.

Currently, we send the names of recognized food ingredients as search terms as they are, and obtain research results on cooking recipes in which the recognized food ingredients are needed to cook. Re-ranking of the returned results from the Web API of cooking recipe sites considering various elements including prices, amounts and user's preferences is our future work.

3. IMPLEMENTATION

We implemented the proposed system on Android-based smartphones using the OpenCV library. In case of Samsung Galaxy S2 (1.5Ghz dual core, Android 2.2), it took 0.15 seconds to recognize an ingredient once with the built-in camera. For the evaluation of the 30 kinds of the trained linear SVMs in the one-vs-rest way, it takes only 0.03 seconds of the total recognition time, since we need to calculate inner products only thirty times to do that.

As a data set for training, we collected 10 short videos per ingredient category for 30 kinds of food ingredients (Table 1) at grocery stores. Since we use multiple frame object recognition, we collected short videos instead of still images. Each of the videos was recored for about 5 seconds in 25 fps with the VGA (640×480) resolution.

To evaluate recognition performance, we carried out evaluation of object classification performance with 10-fold cross validation. For 30 kinds of food ingredients, the proposed system has achieved the 83.93% classification rate within the top six candidates.

Note that the application for Android smartphones of the proposed system can be downloaded from `http://mirurecipe.mobi/e/`.

Table 1: 30 kinds of food ingredients in the data set.

types	ingredients
fish (5)	tuna, squid, octopus, shrimp, salmon
meat (6)	beef, pork, chicken, minced meat, sausage, ham
vegetable (13)	mushroom, potato, eggplant, carrot, radish, tomato, cucumber, cabbage, green onions, onion, Chinese cabbage, lettuce, Shiitake mushroom
fruit (6)	apple, strawberry, pineapple, orange, banana, grapefruit