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Comparative Analysis of Different Features and Encoding Methods for Rice Image Classification

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***Abstract*—Rice is the most widely consumed staple food in Sri Lanka. In this paper, we present a comparative study of different features (SIFT, Multi-resolution Local Patterns, Local Color Histograms, and Random Projections) and feature encoding approaches (Bag-of-visual-words, Sparse Coding, Vector of Locally Aggregated Gradients, and Fisher Vectors) for classifying images containing rice grains. By analysing the performance of a classification model with two-fold cross validation on a dataset of 1000 images containing ten rice categories, we show that SIFT features with Fisher Vector encoding or with Vector of Locally Aggregated Gradients produces the best result (mean class accuracy of 97.9 ± 0.5). We found that increasing the size of the dictionary generally improves the classification performance for all the feature encoding approaches. The dataset we use is made public, and it can be accessed via http://www.csc.jfn.ac.lk/index.php/dataset/.**

***Index Terms*—image classification, features, feature encoding, bag-of-visual-words, SIFT and Fisher Vectors**

I. Introduction

Rice is the most widely consumed staple food in Sri Lanka. There are many varieties of rice exist in the market. They differ from each other mainly based on the features such as size, shape and color. Automatic identification of rice varieties would be very useful for the consumers, for example, a consumer can take a photo of the rice displayed in the supermarket using his/her mobile device and can get more details of it, such as its online price as he/she can automatically identify its category.

In the last decade, various approaches have been proposed for rice image classification, which use different features and classifiers, for example, Kaur et. al. [1] used shape-based features and Support Vector Machine (SVM) classifier, Mousavirad el. al. [2] used morphological features and Neural Networks (NN) classifier, Chaugule et. al. [3] used a set of texture and shape features and a NN classifier, Sumaryanti et. al. [4] used color, texture and morphological features with NN classifier. Most of these approaches try to categorize individual rice grains instead of classifying bulk of rice. Also, based on the literature it is difficult to identify which features and classifiers are best suited for rice image classification as different methods are tested on different small-scale datasets. In addition, to best of our knowledge, feature encoding approaches such as Fisher Vectors [5] have not been applied for rice image classification, although they have been widely applied in other domains [6]. Therefore, in this paper we compare different features and feature encoding methods for rice image classification. In contrast to most of the existing work, we focus on categorizing bulk of rice instead of individual rice grains. Note that in the work related to classifying individual rice grains the accuracy of the system heavily depends on how well individual rice grains are segmented. Since we focus on bulk of rice our system avoids segmenting individual grains from images which contain rice, hence, higher accuracy can be obtained. As an additional contribution we introduced a new dataset with 1,000 rice images from 10 different categories and make it publicly available, which enable other researchers to apply their techniques on this dataset and compare with our technique easily. A few sample images from the dataset are shown in Figure 1.

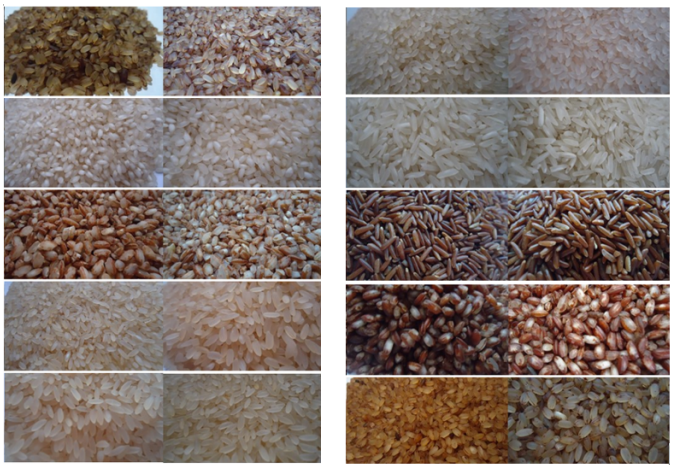

Fig. 1. Example images from our dataset: Each row in the two columns show images from different rice categories.

II. Related Work

As mentioned in Section I most of the existing work (e.g. [1]–[4], [7]–[9]) focus on classifying individual rice grains into one of the predefined categories based on the features such as shape, texture and color and classifiers such as NN and SVM. In these approaches, first, individual rice grains are segmented