MSU CSE 803: Fall 2015
Meal Recognition Project Progress Report

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The first task accomplished by the team was the assignment of priorities to the various food classes, allowing the students to determine where initial efforts needed to be focused. Apples, bananas. broccoli, strawberries, and tomatoes were chosen as the first food classes to focus on, with the use of color, texture, and shape as the main distinguishing features. The team has already collected and labeled the majority of training images and some testing images needed for these initial food classes. Next, rice, french fries, and possibly salad would be added to the list of food classes. As time permits, burger, hotdog, and pizza will be added to list, followed by cookie, pasta, and egg. The team believes these last three food classes to be the most difficult classes to identify due to their vast array of methods to be displayed, including scrambled eggs, fried eggs, different types of cookies, and different shapes and toppings on pasta for example.

Objects in the images will first need to be isolated from their background. To start, the team will focus on images with single objects in them, then expand to deal with multiple objects per image. The present approach involves creating and smoothing an intensity histogram of the grayscale image, and choosing low points in the histogram as thresholds to separate regions. The second moments are calculated on each region, and the one with the largest values is considered to be the background. For better region selection in images with similar foreground and background grayscale values, a K-means color clustering algorithm is being considered to replace or augment this region separation technique.

The primary characteristics the team will use to identify the different classes of food are color, texture, and shape. For color, the HSI color scheme will be used. The goal will be to compare histograms of the colors in an image to determine the class. With the HSI color scheme, the actual value of the hue can be deceiving since a white or black color could be displayed as any hue with a very high/low intensity. In order to combat this problem, when creating the histograms, the hue value will also be multiplied by saturation and intensity values. This will give less weight to color areas with low intensities or low saturations, resulting in a clearer determination of the primary and secondary colors of the region.

Texture should prove to be particularly useful for certain classes such as broccoli and strawberries, which both have a distinct texture. Initial efforts were put into investigating the use of Law's Texture Energy Measures, which outputs a 9-dimensional feature vector for each image pixel - these features can be applied to detect uniform texture in an image. However, due to the

computational complexity and large amount of storage space required for this texture detection algorithm, the team has begun also researching the application of filters that use statistical measures to characterize the texture of an image. Experiments will be performed on training images to determine if these filters are reliable in distinguishing food classes.

Finally, for shape, calculations of circularity, minimum and maximum inertia, and tangent angle histograms will be generated. Shape will be used as a final classification if needed for classes that may have similar color or texture.

For each training image, a feature vector will be developed using the methods described above to represent measures of color, texture, and shape. Each learned vector will be associated with the respective training image's label. The plan for classification of testing images is to calculate the same features for all input images and compare the values of the vector to the training image feature vectors using a K-nearest neighbor classification scheme. The error of the model can then be determined by comparing the predicted label to the actual known label.

All of the code for the project will be developed in MATLAB in order to take advantage of its built in matrix capabilities as well as make use of the Image Processing Toolbox. Although the code may run slower than other programming languages such as C, the overhead needed to get image processing to work is significantly lower in MATLAB. This will allow the team to focus more effort on the actual code needed to identify and classify food.