MT-Diet: Automated Diet Assessment using Myo and Thermal

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Background: According to several recent researches[1][2][3][4], obesity can increase the risk of many diseases such as diabetes, chronic kidney disease, metabolic disease, cardiovascular disease, etc. To prevent and treat the obesity efficiently and effectively, diet monitoring is an important factor.

Purpose: Manual self-monitoring techniques for diet suffer from drawbacks such as low adherence, underreporting, and recall error[5][6][7]. Camera based applications that automatically extract type and quantity of food from an image of the food plate can potentially improve adherence and accuracy. However, state-of-the-art systems[8] have fairly low accuracy for identifying cooked food (only 63%) and are not fully automatic. To overcome these drawbacks such as low adherence, underreporting, recall error, low accuracy, and semi-automatic, we introduce a fully automated diet assessment system, MT-Diet that can identify cooked food with an accuracy of 88.5% which is a significant improvement (over 20%) from the current state-of-the art system.

Methods: MT-Diet is a smartphone-based system that interfaces a thermal sensor and a Myo wrist band with a smartphone. Using this system a user can take both thermal and visual images of his or her food plate with just one click. While a user eat foods, the Myo device monitors hand movements and estimates number of bites taken by the user. We used a database of 80 frozen foods which contain several different type foods so that the actual total number of our food database 244 and the database has 33 different type foods. By using the database, we evaluated three core components: a) food segmentation, separating food items from the plate and recognizing multiple food items as a single food item, b) food identification, determining the type of foods, and c) food intake measurement, identifying the utensil and an amount of foods the user ate.

Results: MT-Diet food segmentation methodology is fully automatic and requires no user input as opposed to recent works, and the accuracy of recognizing multiple foods as a single food was 92.5%. The accuracy of food identification using Support Vector Machine with Radial Basis Function kernel based on color, texture, and histogram of oriented gradients features is 88.5%. The accuracy of detecting a bite using Dynamic Time Warping based on accelerometer data from Myo device was 91.37%.

Conclusions: We suggest a new and novel approach for diet assessment, MT-Diet. Our approach can potentially be an inexpensive, real time for the feedback on calorie intake, easy-to-use, privacy preservation, personalization based on eating habits of individuals, and fully automated diet monitoring system. The tool can also be used to conduct clinical studies to develop models of meal patterns that can be incorporated to design better artificial pancreas.
Reference


