Center for Embedded Networked Sensing

Image Quality Assessment and Clustering for DietSense

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Introduction: Mobile Sensors and DietSense

Mobile Sensors

• **Digital cameras on mobile phones are a beneficial source of sensing human activity and the environment.**

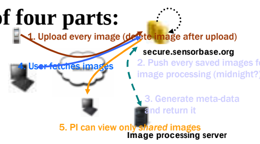
One application of these sensors is monitoring dietary intake. Dietary patterns are recognized as an important contributing factor to disease.

DietSense

▪**DietSense is a software system that takes advantage of the use of mobile phones with digital cameras and web management to accurately document the dietary intake of the patients.**

▪**The DietSense architecture consists of four parts:**

1.Mobile phones
2.A data repository
3.Image Processing Tools
4.Data collection management tools



Problem Description: Provide a Set of Images That Best Represents One's Dietary Intake

For the DietSense campaign, mobile phones are worn on a lanyard around the neck with the camera facing outwards. The participants start image capture at the beginning of their meal and the phones (running custom software) autonomously take images every ten seconds and upload them to a secure database called SensorBase.

▪**The resulting set of Images contains overexposed, underexposed, blurred and redundant images**

▪**The number of digital images obtained by these sensors during each meal ranges from 100 to 200 images**

▪ To keep the user interface simple, we wish to display only 35 images for patient recall.

A set of 35 good quality images that best represents one's dietary intake is needed.

Proposed Solution: Filter Out Poor Quality and Redundant Images

Image Processing

▪ **Image Quality Assessment:**

•**Detecting Underexposed and Overexposed Images Using:**

1. Standard Deviation Value of the Intensities of an Image
If the standard deviation value is low, the image has a lightly varying intensity throughout the image and thus is a good candidate for under or overexposure.

2. Robert's Edge Detection Algorithm
If the number of edges detected in an image is low, the image has a low edge structure and thus is a good candidate.

9. STD: 29.9313 mean: 24.4628 UNDEREXPOSED

Edge count: 1632 UNDEREXPOSED

Algorithm 1. results

Algorithm 2. results

•**Detecting Blurry Images Using:**

1. Discrete Cosine Transform and a High Pass Filter
If the high frequency content of an image is low, the image does not contain many large intensity differences among its neighboring pixels and it does not contain well defined edges, thus is likely a blurred image.

2. Harris Corner Detection Algorithm
If the number of corners detected in an image is low, the image does not have a clearly defined structure and therefore it is likely blurry.

Algorithm 1. results

Algorithm 2. results

Fig 45. freq: 0.097024 BLURRY

Corner count: 0.021944 BLURRY

Blurry

Fig 72. freq: 0.3083

Corner count: 0.39306

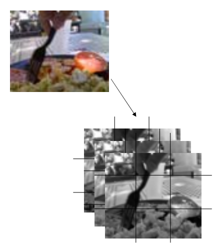
Non-Blurry

▪ **Clustering Similar Images**

•**Color-Based Clustering**

- Segment the image into 9 blocks
- Obtain 16 bin histograms of R, G, B in each segment
- Compare each segment with the corresponding segment of another image
- Determine similarity

•**Texture-Based Clustering**



- Separate the R, G and B contents of the image
- Segment each image into 9 segments
- Low pass filter and average the frequency content of each segment
- Compare the values of each segment of each color with the corresponding segment of another image
- Determine Similarity

Experimental Results

	STD Alg.	Edge Detection Alg.
Average processing time per image (sec)	0.0866	0.7402
Efficiency: $\frac{Total\# - (FP+FN)}{Total\#}$	0.9429	0.9429

Image Quality Assessment

	DCT Alg.	Harris Corner Detection Alg.
Average processing time per image (sec)	0.3780	0.7953
Efficiency: $\frac{Total\# - (FP+FN)}{Total\#}$	0.9134	0.9291

Image Clustering

Future Work

•Adaptive Threshold Algorithm