Using multimedia to improve medical e-learning

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Introduction

- It is presented the multimedia component included in TESYS, a medical e-learning platform that is used nowadays at the University of Medicine and Pharmacy Craiova at disciplines like gastroenterology and urology in order to complete the traditional medical learning process.

- The multimedia component contains a database with color medical images acquired by teachers from different patients in the diagnosis process, so represent real cases.

- The multimedia component together with modern search methods: content-based image query and content-based region query is used both in the training process and e-testing one.

- The content-based visual query uses characteristics that are automatically extracted from medical images (color, texture, regions).
Extracting the color feature

- The color information from the image is represented by means of the color histogram and by the binary color set.
- The color information is stored in the database as a vector with 166 values and it is used furthermore in the content-based image query and content-based region query.
- The similitude between the query and target image is computed using the histogram intersection:

\[
d_{q,t} = 1 - \sum_{m=0}^{M-1} \frac{\min(h_q[m], h_t[m])}{\min(|h_q|, |h_t|)}
\]
Extracting the color feature

The transformation from RGB to HSV system color.
Extracting the texture feature

- Together with color, texture is a powerful characteristic of an image, which is present in nature and in medical images also.
- Thus a disease can be indicated by changes in the color and texture of a tissue.
- The effectuated studies on medical images indicated that among the most representative methods of texture detection are the Gabor representations, reason for which it was chosen for extracting the colour texture feature from medical images in the database.

\[ D^2(Q,T) = \sum_{f} \sum_{\varphi} d_{f\varphi}(Q,T), \text{where } d_{f\varphi} = (f^Q - f^T)^2 \]
Extracting the color regions

- The extraction system for color regions has four steps:
  - the image transformation, quantization and filtering (the transformation from the RGB color space to HSV color space and the quantization of the HSV color space at 166 colors)
  - back-projection of binary color sets
  - the labelling of regions
  - the extraction of the region features

- The color regions are stored in the database with the following characteristics: the color set, the area (the number of pixels) and the minimum bounding rectangle that bounds the region.
Extracting the color regions

The detected color regions
An example of e-testing using the content-based image query on medical image database
An example of e-testing using the content-based region query on medical image database

Diagnosis: 
Observations: 

- Region0
- Region1
- Region2
- Region3
- Region4
- Region5

Images Retrieved

- Relevant
- Non-relevant

- Relevant
- Non-relevant

- Relevant
- Non-relevant

- Relevant
- Non-relevant
Conclusion

- The multimedia database with many real images comes to complete the small number of images in the medical courses.
- The e-testing solutions complete the traditional testing methods.
- Because there are many images in the database, the student can understand better why similar images from color and texture points of view belong to different diagnoses.
- The multimedia module can be used by students, but also by young specialists that want to improve their skills in reading medical imagistic.
- The teachers and students from University of Medicine and Pharmacy – Craiova, found our multimedia module that uses content-based visual query methods in learning and testing, original and efficient.