International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

Medical Information Retrieval in Mobile Devices

Bibek Raj Dhakal[1], Prof. Dr. A. Damodaram[2]

[1]M. Tech Student, Jawaharlal Nehru Technological University, School of Information Technology, Hyderabad, India

[2]Jawaharlal Nehru Technological University, School of Information Technology, Hyderabad, India

Abstract: ***The purpose of this paper is to describe medical information retrieval in mobile device to access peer-reviewed information based on textual search and content based image retrieval (CBIR). CBIR consists of retrieving the most visually similar images to a given query image contained in a database of images. In medical diagnosis, the visual characteristics of an image carry diagnostic information and visually similar images correspond to the same disease category. By consulting the output of this system, the physician can gain more confidence in his/her decision or consider other possibilities. The increased need of content based image retrieval technique can be found in a number of different domains such as Data Mining, Education, Medical diagnosis etc. Mobile information and communication systems in Medical diagnosis have the potential to greatly improve communication, facilitate information access and increase the quality of patient care.***

Keywords: Content based image retrieval, Mobile Information Retrieval

1. Introduction

Health care is a fundamental need. Health care decisions are refined during corridor discussions in hospitals. The access to medical information has a limited life. Communication device and access to information outside clinician's office are scarce [1]. Medical practice relies on data available on patients and usually tries to find evidence for or against specific diagnosis leading to further examination or treatment. Decisions are thus often taken based on probabilities for or against a specific diagnosis. Currently most use of the data is per patient but reusing the data to find connections and help solving cases with data of other past cases can improve current care [2].

Physicians are highly mobile in hospital. They move from one department to another frequently. Patient record information is not always available during doctors' rounds. Current literature available in the library cannot be directly accessed at patient bedside. The use of mobile devices has great potential to solve at least a part of these problems and to fulfill information and communication needs in health care. It can support both communication and information processing, where an appropriate infrastructure is available. Physicians can look up patient records, and research drugs and other medical information on these devices.

In this paper, we develop content-based image retrieval (CBIR) for feature extraction of medical images. Then we compare this feature with the features stored in the database of the existing images using Euclidean distance to find the similar images.
The small size screens of mobile device limit the displaying of long lists which causes repetitive scrolling and zooming. Also, the data transferred has to be optimized. This thing has to be taken into account when creating applications for mobile device. So instead of providing detail information, it is better to provide the summary of the information.

2. Background

2.1 Content Based Image Retrieval

Content-based image retrieval applies to techniques for retrieving similar images from large collection of images, based on feature extraction methods. Applications of medical CBIR systems appear in the fields of computer-aided diagnosis, evidence-based medicine, case-based reasoning, and medical training. As a basic principle of CBIR, images are internally represented by numerical features, which are extracted directly from the image pixels. These features are stored in the database along with the images, and are indexed for rapid access. At retrieval time, the query-by-example is usually applied. The user presents a sample image or pattern, and the system computes the numerical features, compares them to those stored in the database, and returns all images with similar features. The quality of response depends on 1) the features representing the image and 2) the distance or similarity measure that is used to compare features from different images. The distance or similarity measure is usually specific to a particular feature. Euclidean distance is applied for calculating distances between each pair of signatures. Several approaches are used to compute signatures:

1) Global image features are defined as those that are computed on the entire image, e.g., histogram representation of the image. Only one signature is related to each image.
2) Local features are defined as those that are computed in prominent image regions, e.g., texture or shape features localized at a particular region of interest. A number of signatures are related to each image.
3) Relational features have not yet been applied routinely, but the concept has been discussed. The idea is to capture the spatial and/or temporal relationships between the image regions of interest, such as distance, direction, and size relationships.
4) Hybrid features include a combination of text and image features.

Licensed Under Creative Commons Attribution CC BY

5) Medical image retrieval techniques are broadly similar to techniques employed in non-medical systems. The most significant difference is that in medical system, the regions of interest (ROI) potentially relevant for a specific disease are often extremely small. Search by ROI is one of the most frequently requested functionality of radiologists.

2.2 Mobile Information Retrieval

Mobile Information Retrieval (IR) [5] is concerned with the indexing and retrieval of information for use in mobile devices. According to a recent study, mobile devices will surpass computers as the primary tool for Internet connectivity by 2020. Two main themes characterize research in this area: context awareness and content adaptation. By exploiting the sensors within a mobile device, Context awareness analyzes the user's situation. In contrast, Content adaptation fits the input into the mobile device. Mobile IR analyzes both the content and the context to extract useful information and relationships that traditional IR can't perform. Information presented on a mobile device has to be presented in a different way than on a desktop computer.

3. Implementation

3.1 Architecture

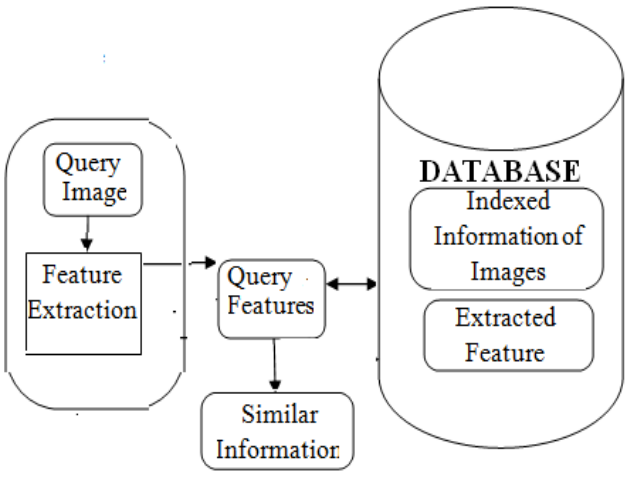

Figure 1: Architecture

The general overview of system architecture is shown in the figure 1. First, the training images are taken and their feature vector is extracted using the content-based image retrieval algorithm. The extracted features are stored in the database. Second, the query image is taken and its feature vector is extracted using the same algorithm as before. Third, this feature is queried against the features stored in the database. Finally, the similarity matching is done between the features and the images in the training set which have more similarity are displayed to the user.

3.2 Content Based Image Retrieval Algorithm

- Convert the given color image to grayscale image using luminance conversion using weighted sum of the three linear-intensity values. The linear luminance Y is given by equation (1) where red, green and blue are corresponding values of the given image in the RGB color space.
  Y = 0.21 * red + 0.71 * green + 0.07 * blue (1)
- After converting the image to grayscale image, we performed the canny edge detection method to get the edge image. There is a chance of having some amount of noise in the images which can be mistaken for edges. So, before doing edge detection, noise must be reduced. Noise reduction is also called as smoothing. For this purpose 5 × 5 Gaussian filter is used. The kernel of a Gaussian filter with a standard deviation of σ=1.4 is shown as follows

$$\frac{1}{159} * \begin{bmatrix} 2 & 4 & 5 & 4 & 2 \\ 4 & 9 & 12 & 9 & 4 \\ 5 & 12 & 15 & 12 & 5 \\ 4 & 9 & 12 & 9 & 4 \\ 2 & 4 & 5 & 4 & 2 \end{bmatrix}$$

- Next step is to compute the gradient magnitude and angle. The canny algorithm basically finds edges where the grayscale intensity of the image changes the most. These areas are found by determining gradients of the image. The gradients at each pixel in the smoothed image are determined by applying the Sobel-filter, i.e., use central differencing using the following 3 × 3 kernels:

$$\begin{bmatrix} -1 & 0 & +1 \\ -2 & 0 & +2 \\ -1 & 0 & +1 \end{bmatrix} \quad \begin{bmatrix} +1 & +2 & +1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix}$$

First step is to compute the derivatives (Dx(x, y) and Dy(x, y)) of the image in the x and y directions. The gradient magnitudes, also known as the edge strength, are determined as a Euclidean distance measure as shown in equation (2).

$$D = \sqrt{D_x(x,y)^2 + D_y(x,y)^2} \quad (2)$$

The angle of the gradient is determined as shown in equation (3).

$$\theta = \arctan\left(\frac{D_x(x,y)}{D_y(x,y)}\right) \quad (3)$$

- The edges found by using the Sobel filter can be either very thick or very narrow depending on the intensity across the edge and how much the image was blurred first. Non-maximum suppression converts the "blurred" edges to "sharp" edges. This is done by keeping only those pixels on an edge with the highest gradient magnitude. These maximal magnitudes should occur right at the edge boundary, and the gradient magnitude should fall off with distance from the edge. The algorithm is for each pixel in the gradient image:
  1) Round the gradient direction θ to nearest 45º, corresponding to the use of an 8-connected neighborhood.
  2) Compare the edge strength of the current pixel with the edge strength of the pixel in the positive and negative gradient direction. I.e. if the gradient direction is north (theta = 90◦), compare with the pixels to the north and south.

Licensed Under Creative Commons Attribution CC BY

3) If the edge strength of the current pixel is largest; preserve the value of the edge strength. If not, suppress (i.e. remove) the value.

- Some of the edges detected will not actually be valid, but will just be noise or color variations. The simplest way to discern between these would be to use a threshold, so that only edges stronger than a certain value would be preserved. The Canny edge detection algorithm uses double thresholding. Edge pixels stronger than the high threshold are marked as strong; edge pixels weaker than the low threshold are suppressed and edge pixels between the two thresholds are marked as weak. Strong edges are considered as "certain edges" and can be included in the final edge image. Weak edges are included only if they are connected to strong edges.
- After the edge of the image is found, its texture feature vector is calculated. It uses co-occurrence matrix to compute the vector.

3.3 Mobile Applications

The application in mobile can be either native, web based or mixed. These applications are discussed as follows:

1) Native Applications: They are installed into the OS and have compatibility constraints. They are not portable but have advantage in execution speed and unrestricted access to sensors such as camera, microphone, GPS, etc. Compilable programming languages differ among mobile OS (e.g., Object C for iPhone OS versus Java for Android).
2) Web-Based Applications: They rely on web programming languages but they have restricted access to sensors. They are portable as there is no need to deploy the software as only URL of the page has to be provided in browser and they don't need approval.
3) Mixed Applications: They are based on web technologies to generate a native application with the help of a specific compiler. They have several advantages, being multiplatform and allowing access to sensors but the development is currently difficult.

4. Results

This section describes the results of the various steps used in this project. We took around 2000 images and computed the feature vectors of them. Then we provided with one sample image to extract the similar images from the stored set.

First, we applied the content based image retrieval algorithm. The output of the various steps of this algorithm is shown in the figure. Figure (2) shows the test image used. Figure (3) shows the grayscale image of the given image. Figure (4) shows the image after removing the noise by applying Gaussian blurs. Figure (5) shows the image after applying gradient magnitudes and finally Figure (6) shows the edge image of the given test image.

Figure 2: Test Image **Figure 3:** Grayscale Image

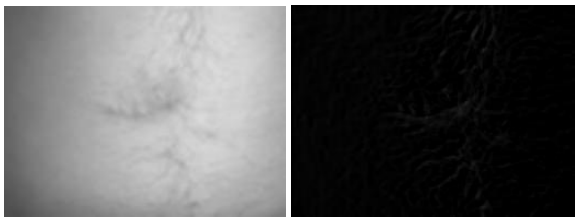

Figure 4: Image after Smoothing **Figure 5:** Gradient Magnitudes

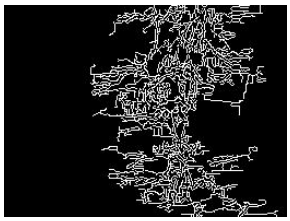

Figure 6: Edge Image

Next, we computed the feature vectors of this image and computed with the feature vectors stored in the database to find out the similar images. In mobile, we used the android OS and displayed the output in both portrait and landscape mode as shown in Figure (7), (8). The image used to test is the test image shown in Figure (2).

Figure 7: Portrait display of similar images

Licensed Under Creative Commons Attribution CC BY

Figure 8: Landscape display of similar images

The query image to be used can be browsed by the user or taken directly from the camera of the smart phone.

5. Discussions and Conclusions

Medical information retrieval in mobile devices focuses on content-based image retrieval to extract similar images from a collection of large images and display them in optimized screen space for handheld devices. The use of mobile devices has grown in a large number and there are some restrictions in using either of the native or web-based applications in mobile devices. Till the mixed application comes into practice, we can use either of the above two applications or use some other framework to utilize the benefit of both native as well as web-based applications.
We believe medical information retrieval in mobile devices has the potential to facilitate Mobile information and communication systems in Medical diagnosis which greatly improves communication, facilitates information access and increases the quality of patient care.

References

[1] A. Depeursinge, S. Duc, I. Eggel, H. Müller, "Mobile Medical Visual Information Retrieval," IEEE Transactions on Information Technology in Biomedicine, vol. 16, no. 1, January 2012
[2] H. Müller, "Medical (Visual) Information Retrieval." [Online]. Available: http://publications.hevs.ch/index.php/attachments/single/531
[3] E. Ammenwerth, A. Buchauer, B. Bludau, and R. Haux, "Mobile information and communication tools in the hospital," International Journal of Medical Informatics, vol. 57, no. 1, pp. 21–40, 2000.
[4] T. M. Deserno, S. Antani, and R. Long, "Exploring access to scientific literature using content–based image retrieval," SPIE Medical Imaging, vol. 6516, San Diego, CA, USA, 2007.
[5] F. S. Tsai, M.Etoh, X. Xie, W. C. Lee, Q. Yang, "Introduction to Mobile Information Retrieval." IEEE Computer Society, Guest Editors' Introduction, January/February 2010.
[6] D. Machado, T. Barbosa, S. Pais, B. Martins, G. Dias, "Universal Mobile Information Retrieval." Conference: Universal Access in Human-Computer Interaction. Intelligent and Ubiquitous Interaction Environments, 5th International Conference, UAHCI 2009, Held as Part of HCI International 2009, San Diego, CA, USA, July 19-24, 2009.
[7] H. Salehian, F. Zamani, M. Jamzad, "Fast Content Based Color Image Retrieval System Based on Texture Analysis of Edge Map." [Online]. Available: http://www.cise.ufl.edu/~fishwick/ac/2011/cbir_webpage/index.htm
[8] L. R. Long, S. Antani, T. M. Deserno, G. R. Thoma, "Content-Based Image Retrieval in Medicine," Int J Healthc Inf Syst Inform, 4(1): 1–16, January 2009.
[9] "Canny Edge Detection," [Online]. Available: http://homepage.cs.uiowa.edu/~cwyman/classes/spring08-22C251/homework/canny.pdf

Author Profile

Bibek Raj Dhakal received the Bachelor of Engineering in Computer Engineering from Institute of Engineering, Tribhuvan University, Nepal in 2010. He is pursuing Master of Technology in Computer Science from JNTUH. His research interests include Image Processing, Data Mining, and Machine Learning.

Avula Damodaram received the B.Tech. and M.Tech. degree in computer science and engineering at Jawaharlal Nehru Technological University Hyderabad, INDIA in 1989 and 1995 respectively. He received his Ph.D. in computer science and engineering at JNTUH, INDIA in 2000 with Thesis on Texture Description and Discrimination Using Innovative Techniques of Segmentation and Boundary Detection on Neighbourhood Images. He is Professor of Computer Science and Engineering, and Director of School of Continuing and Distance Education, Jawaharlal Nehru Technological University Hyderabad (JNTUH)

Licensed Under Creative Commons Attribution CC BY