A Mobile Image Search for Tourist Information System

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Abstract: - Currently, the functions of capturing pictures and VDO, sending and receiving data through wireless network are simple for a mobile phone. Mobile phones nowadays act like a personal computer. However, people generally use the keywords or character set to search for information through the computer or mobile phone. In using keywords search, users have to define the appropriate keywords for things that they wanted to search for. Otherwise, the needed information may not be retrieved. In some cases, multiple keywords must be given in order to obtain the satisfied results. However, defining the appropriate keyword is sometimes difficult. This paper proposed a mobile application for searching traveling information by using images taken from a mobile phone camera. The images and traveling information are sent back and forth through the Internet by using Web-services. This proposed system could provide more convenient to users and/or tourists and decreases the restriction of searching information from a mobile phone through GPRS.

Key-Words: - *Mobile phone, Web Services, Image search, Autocorrelogram, Autocorrelogram and Color Different Correlogram, AC/CDC*

1 Introduction

Currently, the number of mobile phone users has been significantly increasing. They mostly take their mobile phones to everywhere they go or travel to. Furthermore, almost of mobile phone models today are built in with high efficiency/resolution digital camera and provided GPRS function for connecting to the Internet effortlessly. Therefore, it is possible to use mobile phones to search for information though the Internet. Users generally use keyword to search for information. However, it sometimes is difficult to identify the appropriate keywords or phase for things in a specific language. To resolve the problems mentioned, the use of images for searching information instead of using keywords is introduced and many researches in the area are developed [13-16].

This image search will help users, especially tourists, search for information they wanted without worrying about describing keywords in any specific language. For example, while the tourists are travelling, they find one of the interesting places without having any information in advance. How do they get information of that place? In this case, asking other people around that location or using the keyword search in the Internet may be a possible solution. However, sometimes it may be very difficult to do that because of the language barrier or difficulty in finding the appropriate keyword. But they know exactly "What are things they looking at?". Therefore, it will be very useful for the tourists if they can search and get more information such as name, location, etc by using the image of what they are looking at.

This paper proposed an information retrieval scheme using image taken from mobile phone camera. The Auto-correlogram and Color Different Correlogram (AC/CDC) algorithm [4] are deployed in the image retrieval system. The images and travelling information are sent back and forth through the system by using Web-services. The rest of the paper is organized as follows: Section 2 describes the overview of the research. Section 3 describes the image retrieval algorithm. Section 4 describes an implementation and testing of the proposed system. Section 5 is the conclusion of this paper.

2. Proposed System Overview

The overview of the proposed system is shown in Figure 1. The idea of this system can be described by using the scenarios as the following. First, a tourist takes a picture he/she sees and saves it into mobile phone. Next, he/she selects a picture and send it to the application and database server through GPRS for the mobile device. When the server receives the picture, the searching/image retrieval process begins immediately. The Autocorrelogram and Color Different Correlogram (AC/CDC) algorithms are used for image retrieval in this proposed system. After searching, the system will list the top ten most similar pictures and return those pictures to the mobile phone. The tourist then selects the picture they think that it is

most appropriate for this case. After selecting, the picture plus information are displayed on the mobile phone screen. The details of image retrieval algorithm are described in the next section.

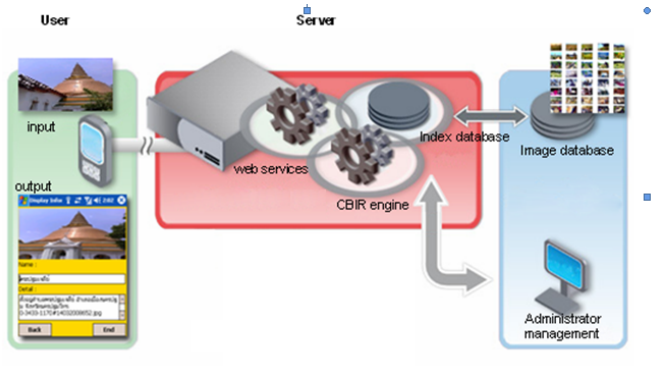

Figure 1 The overview of the proposed system.

3. Background

This section outlines the concepts of web services and the details of algorithms used in the proposed system. A web service is designed to support interoperable mobile-to-server interaction over a network. AutoCorrelogram (AC) is widely used as the visual feature techniques in content-based image retrieval (CBIR) systems. Color Difference Correlogram (CDC) is an extended algorithm based on Auto Correlogram developed by the authors [2][4]. These two algorithms are implemented in the image retrieval system.

3.1 Web Services

A web service [1] is a software system designed to support interoperable machine-to-machine interaction over a network. It has an interface described in a machine-processable format (specifically WSDL). Other systems interact with the web service in a manner prescribed by its description using SOAP messages, typically conveyed using HTTP with an XML serialization in conjunction with other web-related standards as illustrated in Figure 2.

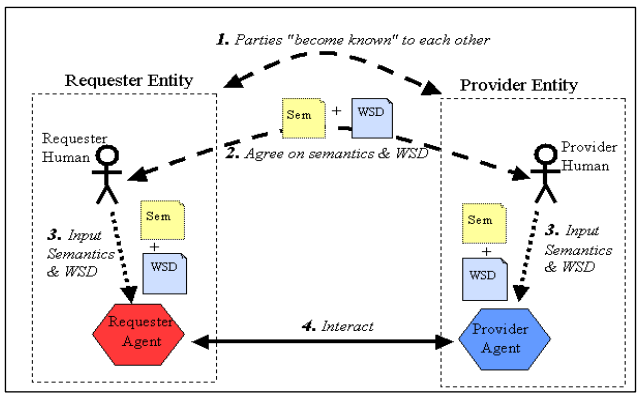

Figure 2 Overview of the use of web services.

3.2 AutoCorrelogram

AutoCorrelogram is one of the widely used visual feature techniques in content-based image retrieval (CBIR) systems. It is a subset of color correlogram [3]. The color correlogram of an image is a table indexed by color pairs. It represents a spatial correlation where the k-th entry for *(i, j)* specifies the probability of finding a pixel of color *j* at a distance k from a pixel of color *i* in the image.

Let I be an n1 x n2 image. The colors in I are quantized into m colors: c1,…,cm. Hci(I) is a number of pixel color ci in I. For a pixel $p=(x,y)\in I$, let C(p) denotes its color. Let Ic ={p|C(p) = c }. The distance between 2 pixels is shown in the example below:

Given that p1=(x1,y1), p2=(x2,y2), defined |p1-p2| = max{|x1-x2|-|y1-y2|} and let n denote the set {1,2,3,…,n} as shown in Figure 3.

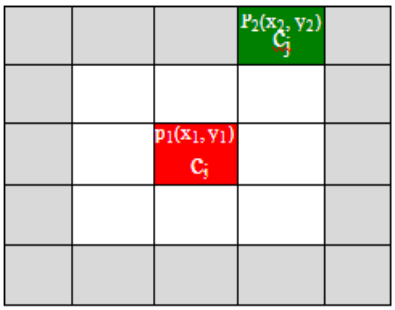

Figure 3 Sample of pixels in an Image for color correlogram calculation.

Let a distance d∈[n] be fix a priori. i, j ∈[m], and k∈[d]. The color correlogram of image I is defined by Eq. 1 and 2.

$$\gamma^{(k)}_{c_i,c_j}(I) \cong \Pr_{p_1\in p_i,\, p_2\in I}[p_2 \in p_j \,||\, p_1 - p_2 |= k] \quad (1)$$

$$\gamma^{(k)}_{c_i,c_j}(I) \cong \frac{\Gamma^{(k)}_{c_i,c_j}(I)}{H_{c_i} \text{ x } 8k} \quad (2)$$

The AutoCorrelogram captures spatial correlation between identical colors only [1]. The technique of AutoCorrelogram is to pick any pixel p_1 of color C_i in the image I, at distance k away from p_1, and pick another pixel p_2, what is the probability that p_2 is also of color C_i? as shown in Figure 4. The formula is shown in Eq. 3.

$$\alpha^{(k)}_c(I) \cong \gamma^{(k)}_{c,c}(I) \quad (3)$$

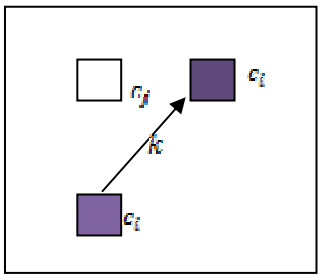

Figure 4 Autocorrelogram of color c_i at distance k.

The two sample images P1 and P2 are used to test with the Autocorrelogram algorithm. See Figure 5. The graph of Autocorrelogram versus Distance of the two sample images is shown in Figure 6.

P1 P2

Figure 5 Sample Images P1 and P2.

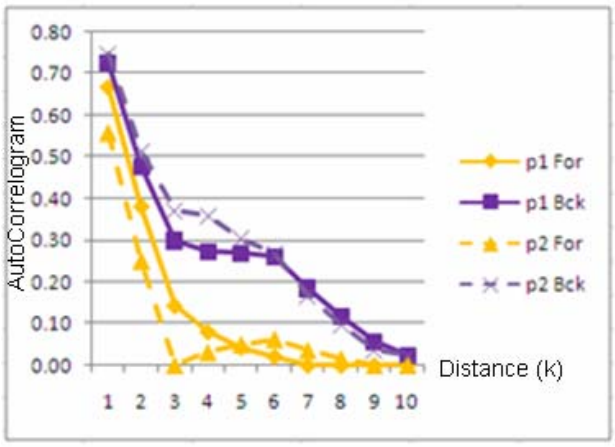

Figure 6 Graph of AutoCorrelogram of the Two Sample Images

3. 3 Color Difference Correlogram (CDC)

Color difference correlogram (CDC) is the scheme that the authors modified from the texture description technique [4]. Color difference correlogram of an image is a graph or table that indexed by color difference value, where the k-th entry for Diffi specifies the probability of finding color difference value Diffi of pixels at distance k from any pixels in image. The color difference value between two pixels having distance equal to k is defined by Eq. 4

$$diffi = | C(p1) - C(p2) | \quad (4)$$

$$where \; | p1 - p2 | = k$$

The color difference correlogram is calculated by the formula in Eq. 5 and 6.

$$CDC^{k}_{diff_i}(I) \cong \Pr_{p_1,p_2 \in I}[\,|C(p_1)-C(p_2)| = diff_i \,|\, |p_1 - p_2| = k] \quad (5)$$

$$CDC^{k}_{diff_i}(I) = \frac{\beta^{k}_{diff_i}(I)}{n_1 x\, n_2 x\, 8k} \quad (6)$$

Where $\beta^{k}_{diff_i}(I)$ is the number of pixels having distance from the centre equal to k and having color difference equal to Diffi. The graph of CDC versus Distance of the two sample images is shown in Figure 7.

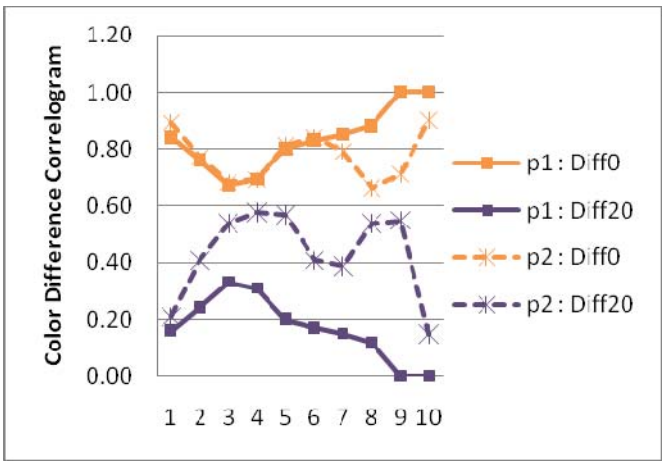

Figure 7 Graph of Color Difference Correlogram of the two sample images.

4. Implementation and Testing

In this section, we describe how each of the separate steps in the architecture have been designed and implemented on Information Retrieval Using Image from Mobile Phone. The overview of the implementation of the proposed system is shown in Figure 8. The picture is captured and sent over the Internet to the web server through GPRS. Web-services on the web server side are provided to handle incoming pictures from mobile phone. Mobile phone application with the web service in a manner prescribed by its description using SOAP messages, typically conveyed using HTTP with an XML serialization in conjunction with other web-related standards. The picture file is indexed and compared with the indexes of all pictures in the database by using AutoCorrelogram and Color Difference

Correlogram (AC/CDC) algorithms. After finishing index comparison, top ten similar pictures will be displayed and returned to the mobile phone application through GPRS.

Figure 8 The implementation of the proposed System.

The details of the implementation are as follows:

4.1 Web Sevices Development**:** In this research, the web services named "WsSIAMTO T.asmx" is developed. See Figure 9. The details of web services are described as follows:

- Web Services Name is Service.asmx.
- Web Method Name is SaveFileAsType. This SaveFileAsType method converts all image file formats such as *JPG, *.GIF, *.BMP, *.ICO to binary file and save them into the database. The data type specified in the database is BLOB (Binary Large Object).
- Web Method Name is UpLoadPic. This UpLoadPic method returns all retrieved pictures to the mobile phone application.

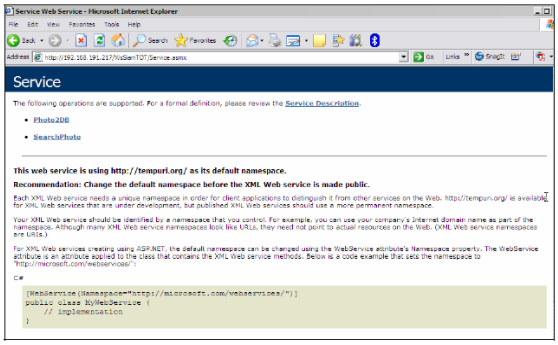

Figure 9 Web Services and Web Methods

4.2 Database Design**:** Microsoft SQL Server 2005 is used for database development in this research. Those pictures in the database have different size and file formats (JPEG BMP and GIF).

4.3 Sample Picture for the Test : One of the interesting and well-known places in Bangkok is the Chakri Maha Prasat Throne Hall. The pictures of the Chakri Maha Prasat Throne Hall are taken in different perspectives. Note that in any taken pictures of that particular place the main interested objects must propotional be at least sixty percent of the picture as shown in Figure 10.

Figure 10 The Chakri Maha Prasat Throne Hall

4.4 Performance Measures: The performance measures use the parameters the sane as described in [3] as follows.

1) r-measure is sums up of the correct answer of queries and average r-measure is the r-measure divided by the number of queries q as shown in the formula below.

$$r - measure = \sum_{i=1}^{q} Rank(Q_i) \quad (7)$$

$$Avg\ r - measure = \frac{r - measure}{q} \quad (8)$$

2) p1-measure is the sum of the precision at the recall equal to 1 and the average p1-measure is the p1-

measure divided by q as shown below.

$$p_1 - measure = \frac{1}{\sum_{i=1}^{q} Rank(Q_i)} \quad (9)$$

$$Avg\ p_1 - measure = \frac{p_1 - measure}{q} \quad (10)$$

4.5 Experiment and Results: The image database consists of 1,061 images in various formats such as JPEG, BMP and GIF and various sizes. The database is considered as a heterogeneous image database. Consider the RGB colorspace with color quantization into 64 colors. Thus, color difference values is set {0,1, …,63}. The distance set d = {1,3,5,7,9,11,13,15,17, 19}. Query set consists of 100 queries, each with a unique correct answer. An example of the query is shown in Figure 11.

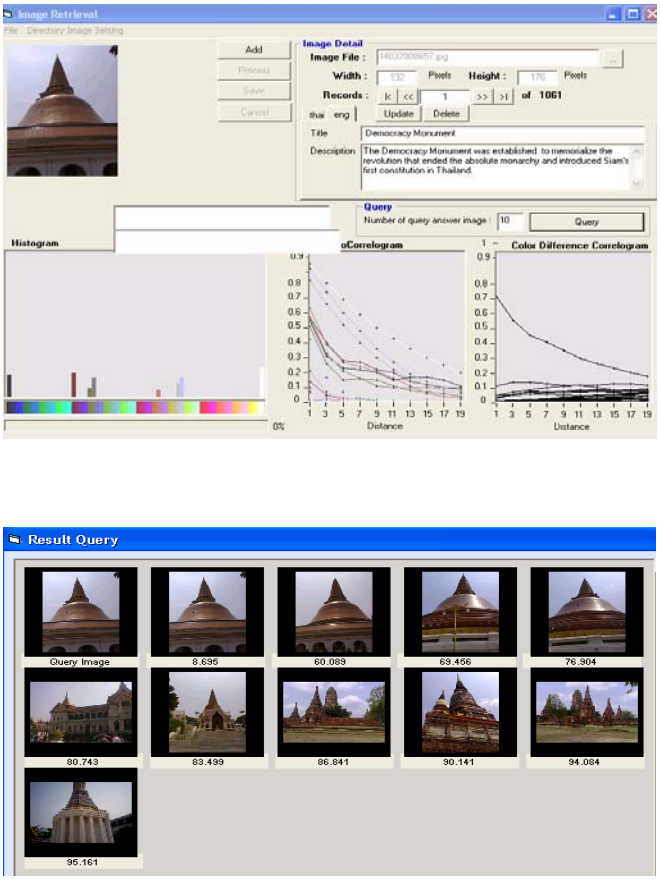

Figure 11. An example of query and its results.

Table 1 shows the results of the experiments. The performance of the proposed scheme is also compared with other methods, autocorrelogram and color difference correlogram [4].

Table 1. Performances of Various Methods

Method	AC	CDC	AC/CDC
r-measure	432	3899	227
Avg r- measure	6	53	3
p_1- measure	61	37	73
Avg p_1- measure	0.61	0.37	0.73

The thirty images query response time is individually measured and recorded. The average response time is 3.15 seconds. The response time is started measuring when the user click "Search". The image is sent over the Internet through GPRS to the web server. After finishing the search, the image results are sent back to the mobile phone. When the mobile phone receives those images, the response time is recorded immediately.

5. Conclusion

An information retrieval scheme using image taken from mobile phone camera is described. The Auto-correlogram and Color Different Correlogram (AC/CDC) algorithm [4] are deployed in the image retrieval system. The system was implemented and tested with the real mobile phone. The experimental results show that the system could be applied for the practical used. However, the system also needs to improve the overall speed of the system.

Acknowledgements
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