IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 1, Issue 4, Aug-Sept, 2013
ISSN: 2320 - 8791
www.ijreat.org

Automatic System for Image-Based Information Retrieval in Mobile Devices

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Abstract

The proposed work deals with image based information retrieval of using mobile device through online application from server to client. An android enabled mobile device is considered as client. The flower databases of twelve classes of simple and composite types are used. The database also includes text information about flower description. Initially the wireless connectivity is established between mobile and server IP address and port number. The flower images are pre-processed using Gaussian filter. The shape and color features are extracted and stored in feature library. The query image is given through mobile device to server. The Java eclipse plugin is run at the server and socket connection is established and query image is downloaded at server side. The features of query image is extracted and compared for similarity using Euclidian distance. Based on distance a recognized index is generated. The text information of the retrieved class is reported to mobile. Hence the proposed work helps for online information of horticulture, formers, Ayurvedic practitioner for information access.

Keywords: *Image retrieval using mobiles, android SDK toolkit, flower recognition and feature extraction, image based information retrieval, online retrieval of information.*

1. Introduction

Information retrieval is a field concerned with the structure, analysis, organization, storage, searching, and retrieval of information. One new and expanding application environment is that of wireless mobile devices such as mobile phones and PDA's. It is therefore natural to suggest that users will to a larger extent base their information retrieval using their networked mobile devices. With mobile applications, some aspects of the user's context, for instance their location, are often available and this context can affect what information is relevant to the user.

Client and Server are needs for retrieving information, today information retrieval systems go beyond the retrieval of traditional documents. Question answering, topic detection and tracking, summarization, multimedia retrieval (for instance image, video and music), software engineering, chemical and biological informatics, text structuring, text mining, and genomics are fields where information retrieval plays a leading part.

Now days the android application is most popularly using for information retrieval system. The proposed work deals with image retrieval using mobiles. A connection is established between client and server using transmitter. Then the client sends a captured image by entering correct IP address of the server and standard port number.

2. Literature survey

From the state-of-out technology, literature survey is carried out to study the relevant work carried in the in the present field. The brief outline of the previous work is as fallows.

Henning Muller, Alba G. Seco de Herrera(2012) has used a subset of the open access collection of PubMed Central was used as the database in 2012, using a larger number of over 300'000 images than in 2011. Depending on the exact nature of the task, visual, textual or multimodal approaches performed better.

Adrien Depeursinge, Samuel Duc (2011) has proposed reviewed medical information based on textual search and content–based visual image retrieval. Medical visual information retrieval on mobile devices was made possible with the MedSearch Mobile prototype described in this paper. The initial MedSearch information retrieval engine was successfully adapted to the various constraints imposed by mobile devices.

Flora S. Tsai, Nanyang Technological University (2010) has developed with the indexing and retrieval of information such as text, graphics, !!ൾ animation, sound, speech, image, video, and their possible combinations for use in mobile devices with wireless network connectivity. It uses context awareness and content adaptation.

Iftikhar Ahmad & Moncef Gabbouj (2010) has presented, a client-server content-based image retrieval framework for mobile platforms is developed, which provides the capability of content-based query and browsing from mobile devices. The proposed framework

provides an adaptive user interface and a generic structure, which supports a wide range of mobile devices. In this framework, a client requests the server for retrieval of particular images with a particular content.

Xavier Anguera, JieJun Xu, Nuria Oliver (2008) has exhibited a multimodal and mobile image retrieval prototype named MAMI (Multimodal Automatic Mobile Indexing). It allows users to annotate, index and search for digital photos on their phones via speech or image input.

Jose Carlos Cortizo, Diego Gachet, Manuel de Buenaga(2008) have presented a description of an intelligent information retrieval system that uses clustering and multi document summarization techniques to present a large set of results in a restricted size environment.

Anne Staurland Aarbakke (2007) thesis describes two systems enabling users to retrieve information such as images, textual information, WAP-links or videos using SMS or MMS. One of the services, M2S is meant for tourists to retrieve information about attractions in Lofoten. M2S uses content-based image retrieval to retrieve the information requested.

The other system, CAIR is meant for users who want to retrieve images from an image collection using SMS. CAIR uses a context-based image retrieval to retrieve images.

Ted Muller and Bjorn Nilsved(2006) has demonstrated a method to explore users experience of general mobile photo-based Web searches to find what issues and phenomena it contains. This was achieved in a three-part study by creating and letting respondents test prototypes of mobile photo-based search systems and collecting data using interviews, observations, video observations, questionnaires, and time measurements.

Xin Fan, Xing Xie, Zhiwei Li, Mingjing Li, and WeiYing Ma (2005) have proposed a system named Photo-to-Search which allows users to input multimodal queries. In this paper, we combined a number of techniques from different domains, including duplicate image detection, content-based image retrieval, text-based Web image search, and key phrase extraction in an ensemble system to provide a feasible solution to support multimodal queries from mobile devices.

Miguel A. Munoz, Victor M. González(2003) have proposed a collaborative handheld system which extends the instant messaging paradigm by adding context-awareness to support the intensive and distributed nature of information management within a hospital setting.

Abby A. Goodrum (2000) has provided an overview of current research in image information retrieval and provides an outline of areas for future research.

3. Proposed architecture

Form the literature cited it is observed that no wok on image based information retrieval using mobile is carried out. Hence the present work deals with image based information retrieval using mobiles for flower database.

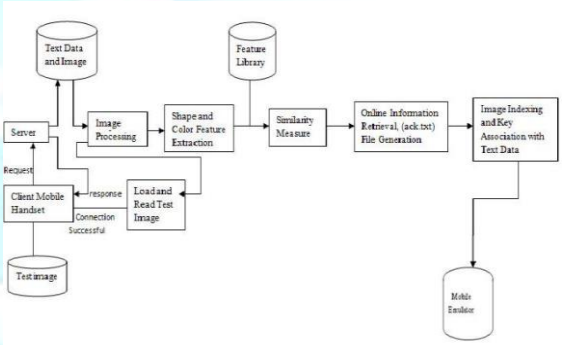


Figure 1: proposed architecture

Now days the android application is most popularly using for information retrieval system. The proposed work deals with image retrieval using mobiles. A connection is established between client and server. Then the client sends a captured image by entering correct IP address of the server and standard port number. Server accepts the client connection, reads the size of the image and image will download then the server checks the identical image, if the image is present it sends the information about the image to the client.

The proposed architecture is as shown in Figure 1 and the modules used in the proposed work are explained as below. The work deals with two component server and client.

A server is a process that is continuously running and waiting to be contacted by a client process. The server process is started on a computer system. In our work server is system, which accepts the client connection and start initializing response. Server contains the data base of our work, the flower images are taken as database.

Eclipse

Eclipse juno is a default platform for building rich client applications. In computer programming, Eclipse is a multi-language Integrated development environment (IDE) comprising a base workspace and an extensible plug-in system for customizing the environment. It is written mostly in Java. It can be used to develop applications in Java and, by means of various plug - ins, other programming languages also.

In our work handheld android mobile is used as client. A client process initiates with the server by connecting to it at a specific port. Using IP address of the server and standard port no client sends a query image to the server from the database, after sending an image it gets response from the server. The image process work is carried at server side, initially images are pre-processed and features are extracted. The different phases are explained in section 3.2

Mobile Emulator

Emulator is an android mobile screen which displays our running application. The Android SDK includes a mobile device emulator, is a virtual mobile device that runs on your computer. Once our application is running on the emulator, it can use the services of the Android platform to invoke other applications, access the network.

Figure 2: Emulator

The latest mobile software platform is Android. The Android build tools—whether Eclipse-integrated or stand-alone—will turn the contents of your project into an Android package (APK) file, which is the Android application. Those tools will also help you get your APK file onto an Android emulator or an actual Android device. The emulator is as show in Figure 2.

3.1 Client-server Communication

The client-server model is a standard model for network applications. At a basic level, network-based systems consist of a server, client, and a media for communication as shown in Figure 3. A computer running a program that makes a request for services is called client machine. A computer running a program that offers requested services from one or more clients is called server machine. The media for communication can be wired or wireless network.

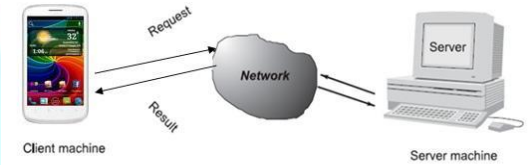


Figure 3: Client – Server communication

Socket

A socket is an endpoint of a two-way communication link between two programs running on the network. On getting correct IP address of the server by client and specific port the server starts initializing response of the client it shows socket has been created
After the connections are established, communication can occur using I/O streams. Each socket has both an OutputStream and an InputStream. The client's OutputStream is connected to the server's InputStream, and the client's InputStream is connected to the server's OutputStream is as shown in Figure 4.

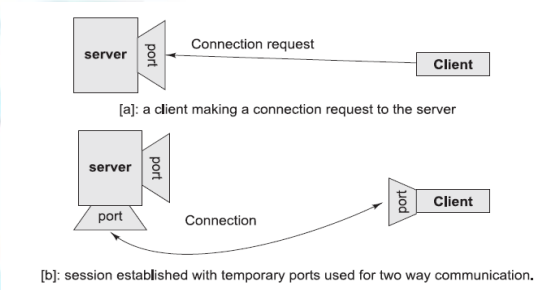


Figure 4: Establishment of path for two-way communication between a client and server

Mobile (client) details

- Model number LG-P715
- Android version 4.1.2(jelly bean)
- Camera 8MP
- Screen 10.9 cm (4.3 inch) LCD
- 1 GHz dual core
- Kernel version 3.40

Android

Android is a Linux-based operating system designed primarily for touch screen mobile devices such as smart phones and tablet computers.

Software platform on mobile device by Open Handset Alliance (Google)

- Developing language is Java
- Linux kernel (Open Source)
- Provides a development kit (SDK)
- Emulator support with some limitation

There are four building blocks to an Android application: Activity, Service, Broadcast Intent Receiver, and Content Provider.

.apk

Android apk is an android application programming kit. Transmitter android .apk file is generated after successfully running the client code at the server side, and then we have to install this apk file in the client i.e. in android mobile. This brings into contact to both client and server. Here we used version4 of transmitter android.

Wi-Fi

Wi-Fi is a popular technology that allows an electronic device to exchange data wirelessly (using radio waves) over a computer network, including high-speed Internet connections. In our work 802.11 and 512 kbps of speed is used.

3.2 Image processing technique at server side

3.2.1 Data acquisition systems

Data acquisition systems, as the name implies, are products and/or processes used to collect Information to document or analyze some phenomenon.

Image acquisition in image processing can be broadly defined as the action of retrieving an image from some source, usually a hardware-based source, so it can be passed through whatever processes need to occur afterward. Performing image acquisition in image processing is always the first step in the workflow sequence because, without an image, no processing is possible.

The image that is acquired is completely unprocessed and is the result of whatever hardware was used to generate it, which can be very important in some fields to have a consistent baseline from which to work. One of the ultimate goals of image acquisition in image processing is to have a source of input that operates within such controlled and measured guidelines that the same image can, if necessary, be nearly perfectly reproduced under the same conditions so anomalous factors are easier to locate and eliminate. In our work image is captured using digital camera of 8MP, the high mega pixels of camera has good clarity of image.

3.2.2 Image Pre-processing

Pre-processing images commonly involves removing low-frequency background noise, normalizing the intensity of the individual particles images, removing reflections, and masking portions of images. Image pre-processing is the technique of enhancing data images prior to computational processing.

The aim of pre-processing is to improve image data so that it suppresses undesired distortions and/or it enhances image features that are relevant for further processing.

RGB image

RGB image is a image which contains red green blue and color, The main purpose of the RGB colour model is for the sensing, representation, and display of images in electronic systems, such as televisions and computers, though it has also been used in conventional photography.

Gray image

Gray scale or greyscale digital image is an image in which the value of each pixel is a single sample, that is, it carries only intensity information. Images of this sort, also known as black-and-white, are composed exclusively of shades of gray, varying from black at the weakest intensity to white at the strongest.

Gray scale images are distinct from one-bit bi-tonal black-and-white images, which in the context of computer imaging are images with only the two colors, black, and white (also called bi-level or binary images). Gray scale images have many shades of gray in between. Gray scale images are also called monochromatic, denoting the presence of only one (mono) color (chrome).

Binary image

A binary image is a digital image that has only two possible values for each pixel. Typically the two colors used for a binary image are black and white though any two colors can be used. The color used for the object(s) in the image is the foreground color while the rest of the image is the background color. This image contains only true and false values that are 0 and 1.

A binarization method of binarizing an image by extracting lightness (brightness, density) as a feature amount from the image.

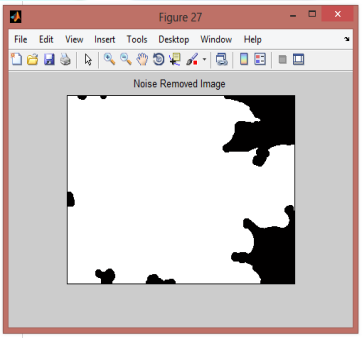
Binary image

Noise removal

Noise is the result of errors in the image acquisition process that result in pixel values that do not reflect the true intensities of the real scene. There are several ways that noise can be introduced into an image, depending on how the image is created. For example:

- If the image is scanned from a photograph made on film, the film grain is a source of noise. Noise can also be the result of damage to the film, or be introduced by the scanner itself.
- If the image is acquired directly in a digital format, the mechanism for gathering the data (such as a CCD detector) can introduce noise.
- Electronic transmission of image data can introduce noise.

To simulate the effects of some of the problems listed above, the toolbox provides the imnoise function, which you can use to *add* various types of noise to an image. The examples in this section use this function.



Flower Region Segmentation

The segmentation of an image is defined as its partition into regions, in which the regions satisfy some specified criteria.

Image segmentation is a process of extracting and representing information from an image is to group pixels together into regions of similarity. Image segmentation may use statistical classification, thresholding, edge detection, region detection, or any combination of these techniques. The output of the segmentation step is usually a set of classified elements, Most segmentation techniques are either region-based or edge based. In order to extract the flower boundary as correctly as possible, the proposed system provides a simple interactive interface which allows the user to select the interested flower for recognition. Figure 5 illustrates the steps of the interactive flower region segmentation phase.

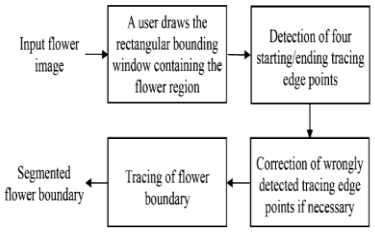


Figure 5: Block diagram for flower region segmentation

Shape and Color feature Extraction

Color and Shape features are collected from input images are used for classification and to get the information of input flower. The shape feature of the flower gives the details about the flower such as height of the petals, number of petals, roundness, and central moment. Four features are taken as shape features.

HSV (Hue, saturation, value) plane is used to get color features of the flower. Based on the co-ordinates of the cell 6 features are taken as color features of the flower. Each of the middle region, inner region and outer region has 6 color features. Hence each flower has 18 color features.

Load and Read Test image

Server loads the image after accepting the client connection and it creates the file stream of the query image which is sent by the client.

Image Indexing and key Association with Test Data

The features of trained images are stored in the feature vector, the features of input flower image is compared with features stored in the feature vector and index value of input image is compared with index value which is stored in the feature vector. Hence the key association is made between input image and stored database.

Online Information Retrieval, (ack.txt) File Generation

The acknowledgment.txt file is generated at the server side and is sent to the client. This ack.txt file contains the information about the input flower image. The ack.txt file will dump at the download folder in the mobile.

3.2.3 Feature extraction

In pattern recognition and in image processing, feature extraction is a special form of dimensionality reduction. When the input data to an algorithm is too large to be processed and it is suspected to be notoriously redundant (e.g. the same measurement in both feet and meters) then the input data will be transformed into a reduced representation set of features (also named features vector). Transforming the input data into the set of features is called feature extraction.

On a captured image, five points are set: $P0$ at the centre and $P1$, $P2$, $P3$ and $P4$ at the middle of four sides as shown in Figure 6.

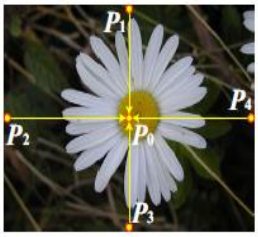


Figure 6: Location of file points.

Then four profiles of local costs along the straight lines from $P0$ to all of the four middle points are computed. Then on each profile, three local minimum points are identified. Consequently a total of 12 points are found. Figure 3 shows four profiles observed from the picture shown in Figure 7.

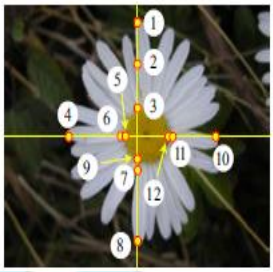


Figure 7: Detected 12 points.

Figure 8 depicts 12 local minimum points. These 12 points are the starting points of our NC method. A new route search method called the normalized cost (NC) method is proposed to deal with flowers with complex boundaries, which searches a boundary with minimizing the normalized cost i.e. the sum of local costs divided by the route length.

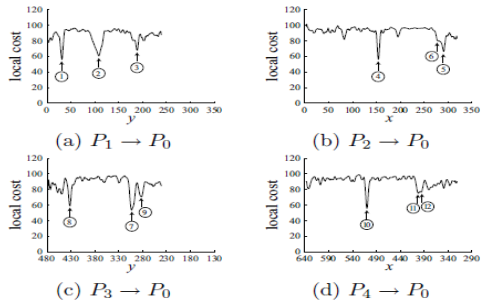


Figure 8: Four cost profiles

Then the NC method is run for each of the 12 points as the starting point. The resulting 12 boundaries or routes are shown in Figure 9.

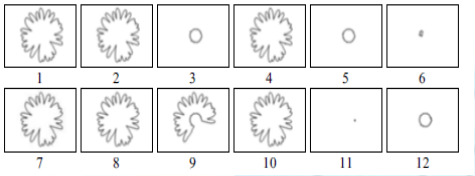


Figure 9: 12 extracted regions.

Color and Shape features are collected from input images are used for classification and to get the information of input flower.

Shape feature

Based upon the extracted boundary, we define the gravity centre of its internal region and identify the starting point where the boundary crosses the y-axis.
Then the length *l* from the starting point is defined along the boundary. Then the distance *d* (see Figure 10) from the gravity centre to the boundary is measured as the function of *l*. The following four features are defined as shape features.

F1: the ratio of the average width over the average height

F1 = *l*/*d*, which is an approximation of the average petal width over the average petal height.

F2: the number of petals, which corresponds to the number of valleys or that of hill tops in the above curve. We assign a number of 'N' representing 'many' in case of more than 7 petals in order to deal with some flowers such as a dandelion which has a large but fluctuated number of petals.

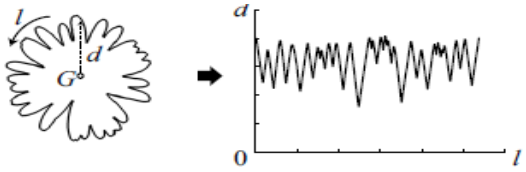


Figure 10: Analysis flower shape.

F3: the central moment is defined as: F3 = 1/*S*Σ*x*Σ*y*_(*x* − *gx*) 2 + (*y* − *gy*) 2_1/2 where *S* is the total number of pixels in the flower region, (*gx*, *gy*) is the centre of gravity of the flower region and (*x*, *y*) is in the flower region pixel.

F4: the roundness, which is an indicator for how much the perimeter shape is closer to a circle, defined as: F4 = 4π*S*/*L*2, where *S* is the same definition of F3 and *L* is the perimeter of flower region. We have 0 < F4 < 1.

Color feature

The camera image is given in the RGB color coordinate. We convert the RGB coordinate into the HSV (hue, saturation and value) coordinate. The HS space is divided into 72 cells where each cell is assigned an identical area (Figure 11). For each flower image, its distribution is computed. Then identify the segment which has the largest entry. The selected features are the following six:

F5: the *x* co-ordinate of the largest color cell.
F6: the *y* co-ordinate of the largest color cell.
F7: the ratio of the largest color cell.
F8: the *x* co-ordinate of the second largest color cell.
F9: the *y* co-ordinate of the second largest color cell.
F10: the ratio of the second largest color cell.

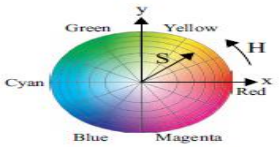


Figure 11: Separate HS space into 12 × 6 cells.

Each middle region, inner region and outer region of the flower has all the 6 color features as explained above. These regions are as shown in below Figure 12.

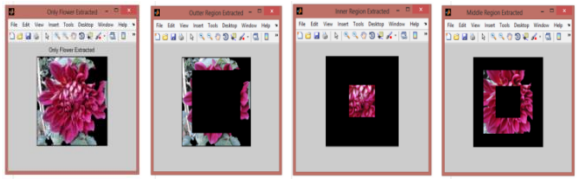


Figure 12: Regions of flower

3.2.4 Similarity Check

The image similarity measure is very important to determine the correspondence between images in order to quantify the accuracy of image registration. The selection of image similarity measure requires a trade-off between speed and performance. It is a measure of correspondence between two images. If the similarity measure is maximal then the images are considered to be correctly aligned. The aligning of two images can be done by using Euclidian distance between images.

4. Results and discussion

In our work initially the image is captured from android enabled mobile of 8MP camera. The image is captured in different angles in such a way that the face of the flower should be towards the camera. The 60 images are taken for testing (12 classes of images, each class contain 5 images). These images are as shown in below Figure13.

Figure 13: flower images

Each input flower image has 4 shape features and 6 color features for each middle region, inner region and outer region flower. Hence the each input flower image has total 22 features in which 18 color features and 4 shape features.

For our work we have to install the android software at the server side and transmitter android apk in client. After connection set up has made between client and server, we can send an input flower image from the gallery through mobile using correct IP address and port number to the server. Here we have selected jenifly flower as a query image, which is as shown in below Figure 14.

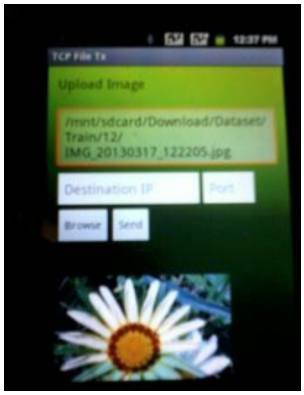
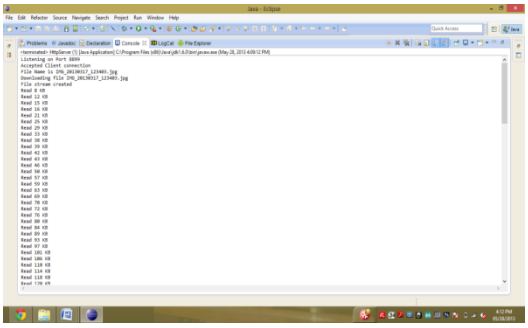


Figure 14: Sending an image

Server accepts the client connection and creates the file stream i.e. it reads the size of the image sent by the client. Image file will download at the server side and it starts initializing response and waits for the ack.text file, for example which is as shown below Figure 15.



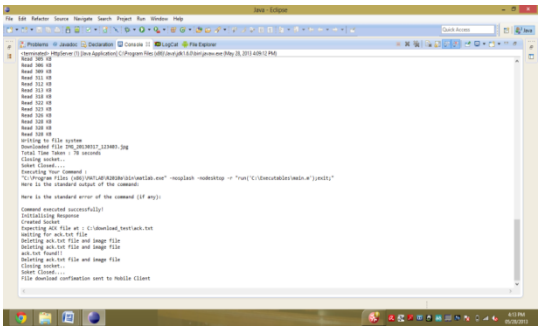
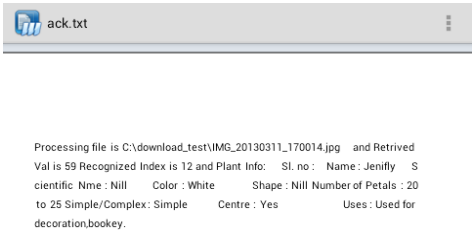


Figure 15: Process of image downloading



The ack.txt file contains the information about the input flower image, once the ack.txt file found it is send to the client and the socket is closed between the client and server. Then file download confirmation acknowledgement is sent to the mobile client and acknowledgement received message displayed on the mobile screen. Finally information about the input flower i.e. jenifly flower image is displayed in the mobile, is as shown in figure 16.1 and 16.2.

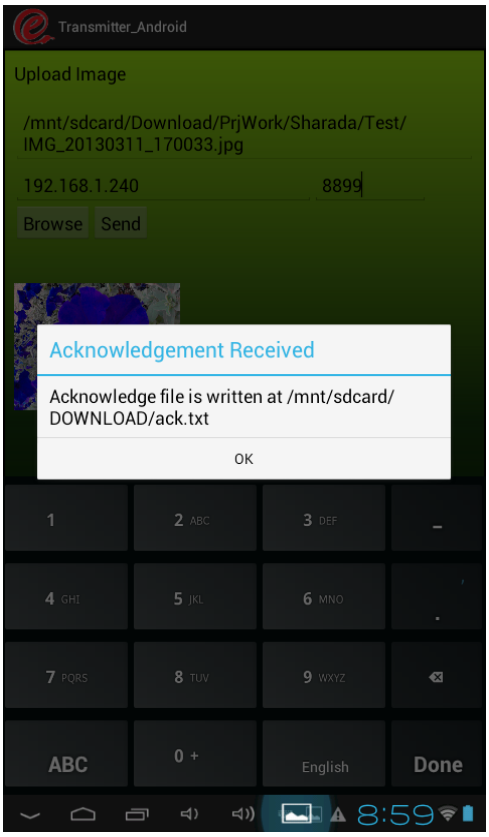


Figure 16.1 ack.txt file

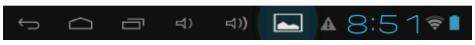


Figure 16.2 Acknowledgement

5. Conclusion

Information retrieval system is an emerging system in the mobile environment. On sending an image from the client (mobile) to the server, we can get the information about that image within a second from the wireless network.

In this our work the Wi-Fi system plays an important role. The time taken to download the image from the mobile at the server side and retrieve the information is depends on the size of the query image and speed of the wireless network.

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