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Research Article

Searching and Retrieval of Multimedia Files using Annotation on Low End Mobile Devices

D. P. Pandit*[a] and L.M.R.J. Lobo[b]

[a]Department of Computer Science and Engineering, Solapur University, Walchand Institute of Technology, Solapur, Maharashtra, India
[b]Department of Information Technology, Solapur University, Walchand Institute of Technology, Solapur, Maharashtra, India

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Abstract

The immense growth of mobile technologies permitted user to capture and store the multimedia files on mobile devices. It has become the hectic work for user to find a particular file of interest from huge file system of low end mobile device. In this paper we have introduced semantic file annotation technique for automatic annotation of files in mobile device. The searching and retrieval of a file from low end mobile device is based on annotation. Semantic file annotations are the meaningful comments we may apply to describe, illuminate, and remark about any multimedia file in our mobile device. Annotation are metadata, added to the files such as image, audio and video, which makes us easier to search and retrieve files quickly from our mobile phone or from PAN (Personal Area Network) with the help of Bluetooth.

Keywords: *Annotation, J2ME, PAN, Bluetooth, XML, KXML, Mobile, Searching, Retrieving, multimedia files.*

1. Introduction

As the mobile technology has been developed tremendously, come up with many research and huge memory. The mobile phones evolved with camera so the user captures more and more digital images or record videos and store them to a huge memory of the mobile device. With the increasing number of mobile phone users, more personal digital image has been produced day to day. When the user captures images with help of camera, by default they have been stored in memory with the name like image001, image002, image003 and when record videos they have been stored with the name as video001, video002, video003 and so on. It has become very hectic for user to perform searching and retrieve such files with such names, because those names are very hard to recall (A. Makadia *et al*, 2010). So it has become a challenging issue for user to get quick access to a particular file of his interest from huge file system of mobile device. So to get sudden access to these files, semantic based file annotation technique has been implemented. In which file attributes have been extracted automatically and are used as metadata to the file (A. Craig *et al*, 2003). Also they have been annotated with a keyword or a description which is an optional part. So that the user may perform effective search for files through these additional attributes like description or keywords and retrieve them easily either from mobile device or from PAN (Zhichen Xu *et al*, 2003). In this paper, the whole framework have been implemented on java enabled low end mobile device like mobile phones, Personal digital Assistants (PDA), other Mobile Information Device Profile (MIDP) compliant devices (S. Jan *et al*, 2010).

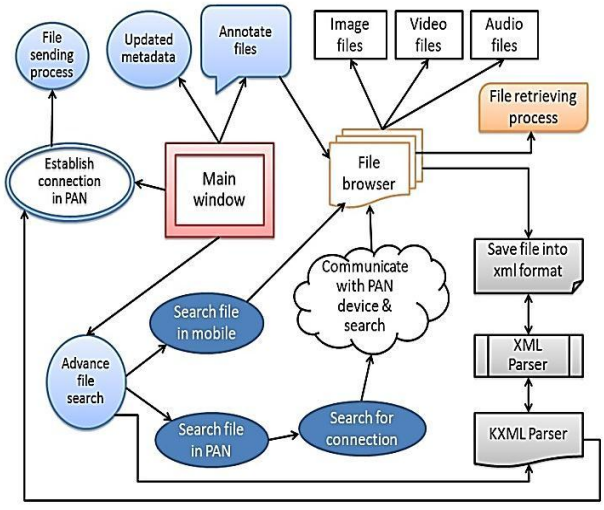

Fig. 1: System Design Architecture

Annotation is the main tool to associate semantics with an image. Annotation highlights the significant role of photos in restoring forgotten memories of visited places, party events, and people (W. Viana *et al*, 2007). As shown in the fig. 1 Moreover the use of annotation process allows the development of better organization, searching and retrieval processes for personal file management (A. Makadia *et al*,

*Corresponding author: **D. P. Pandit** is a M.E. student ; **L.M.R.J. Lobo** is working as Professor and Head of the department

2010). The existing approach in this paper for multimedia annotation shows several representation structures to associate metadata with images. This approach automatically extracts the metadata like name, size and date of file from the file system and uses this information as annotation tag for resultant file and parses it using k-XML parser to store in XML structure. The meta-data of the files is stored in an Extensible Mark-up Language (XML) format, XML format can also be viewed as a browsing list on the mobile screen. Simultaneously, it also allows users to edit or refresh the meta-data at any time. Search module uses Bluetooth connection to search for a file in PAN environment or in mobile phone itself.

XML is a meta-markup language which was approved by World Wide Web Consortium (W3C) and has become universally accepted specification for exchanging documents and data across applications and platforms. We have used kXML which is a lighter and compact version of XML parser specially designed for low-end devices to parse XML data and is entirely used on J2ME platform. We mainly used two types of parsers include push and pull parser. Push parsers process data definitions before the creation of tree structure in memory, while pull parser reads the data first before it starts parsing. Pull parser uses recursive functions to build document tree and hence are more appropriate for handheld devices (S. Jan *et al,* 2010). Furthermore In this paper we describe a content metadata creation process in which keywords and description are added for multimedia files within a mobile phone. Content metadata gives the meaning of what is in the media, for example, who are the people in the picture, where was a scene in a movie shot, or what concert is this audio track from (A. Wilhelm et al, 2004). Addition to this, it describes the semantic structures in media, like who is doing what to whom in a picture (R. Sarvas et al, 2004). When multimedia files are accomplished with annotation, then the files have been searched from the mobile phone or they might be retrieved from PAN with help of Bluetooth. Once the connection is established with other mobile device in PAN, the file can be searched and retrieved easily.

Bluetooth is a wireless communication protocol mainly used for short distance and in devices with low power consumption. Because Bluetooth is capable of communicating in an Omni-directional manner of up to 30 feet at 1 Mb/s it is far superior to infrared. The network formed by Bluetooth enabled devices is called a PAN, which stands for Personal Area Network.

1.1 J2ME

Java 2 Micro Edition (J2ME) is a development and runtime environment designed to put Java software on consumer electronics and embedded devices. J2ME software applications will likely control or provide some type of service on our cellular telephones, pagers, personal digital assistants (PDAs), televisions, VCRs, wristwatches, home appliances, electronic entertainment systems, etc. J2ME applications will help us make telephone calls and order products. The J2ME environment consists of a virtual machine (VM), a configuration and one or more profiles. The virtual machine defines the contract between the configuration and the native operating system. Profiles define the contract between an application and the J2ME environment (J. White *et al*, 2002).

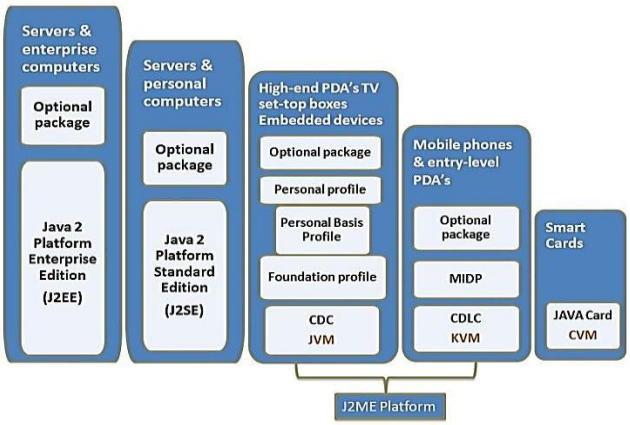

Fig. 2: J2ME Model with various building blocks

As shown in fig. 2 J2ME is divided into configurations, profiles, and optional APIs, which provide specific information about APIs and different families of devices. A configuration is designed for a Specific kind of device based on memory constraints and processor power. Profiles are more specific than configurations. A profile is based on a configuration and provides additional APIs, such as user interface, persistent storage, and whatever else is necessary to develop running applications for the device (k. Topley *et al*, 2002). J2ME holds up to a variety of devices with different capabilities. These devices often vary in the areas of user interface, data storage, network connectivity and bandwidth, memory budgets, power consumption, security, and deployment requirements.
J2ME defines two configurations:

a) Connected Limited Device Configuration (CLDC)
b) Connected Device Configuration (CDC)

The CDC uses the C-Virtual Machine (CVM) and the CLDC uses what is referred to as the Kilobyte Virtual Machine (KVM).The CDC addresses devices and network appliances with more resources than CLDC (J. White *et al*, 2002). J2ME consists of a compressed edition like Kilobyte Virtual Machine (KVM) instead of full Java Virtual Machine (JVM) to make the complete architecture more modular and scalable. The J2ME consists of Stack which is a combination of Configuration, profile and optional APIs. Configuration is used for a specific kind of devices which specifies a JVM and Additional APIs (Application Programming Interface). Profiles are more specific than configuration and are based on a configuration which adds APIs for user interface, persistent storage, etc. Optional APIs are additional functionality including Bluetooth, Multimedia, Mobile 3D, etc. The standardized specifications for both configurations are defined in Java Specification Request (JSR)-139.

Foundation Profile serves as a base for additional CDC profiles that provide graphical user interface, data storage, distributed Java networking, and so forth. In addition to its

duties as a base profile, the Foundation profile provides rich network support for high-bandwidth, high-fidelity connectivity devices. This profile is intended to be used with other profiles to provide a rich application environment for devices smaller than personal computers (J. White *et al*, 2002).

Personal Profile is the new home for many of the Personal Java APIs. The Personal-Java API, which targets pocket PCs, is being re-architected so that it fits into the design of the J2ME architecture. Personal Java will be divided into the CDC, the Foundation Profile and the Personal Profile. Extensions of the Personal Profile include Java Phone and Java TV APIs (J. White *et al*, 2002).

Personal Basis Profile adds basic user interface functionality to the Foundation Profile. It is intended to be used on devices that have an unsophisticated user interface capability, and it therefore does not allow more than one window to be active at any time (k. Topley *et al*, 2002).

Mobile Information Device Profile (MIDP) profile adds networking, user interface components, and local storage to CLDC. This profile is primarily aimed at the limited display and storage facilities of mobile phones, and it therefore provides a relatively simple user interface and basic networking based on HTTP 1.1. MIDP is the best known of the J2ME profiles because it is the basis for Wireless Java and is currently the only profile available for Palm operating system-based handhelds (k. Topley *et al*, 2002). MIDP applications are called as MIDlets running in KVM. A MIDlet is a Java application designed to be run on a mobile device. More specifically, a MIDlet has as its core Java classes the CLDC and MIDP. A MIDlet suite consists of one or more MIDlets packaged together using a Java Archive (JAR) file (JSR-118, JSR-37).

A JAR contains a file known as a manifest which describes the contents of the JAR named manifest.mf and is stored as parts of the JAR file itself. In addition to a JAR file, a Java Application Descriptor File (JAD) file is available as part of the MIDlet suite to provide information about the MIDlet(s) within the JAR. The motive behind including a JAD file is as follows:

A. To provide information to the application manager about the contents of a JAR. With this information, decisions can be made as to whether or not a MIDlet(s) is suitable for running on the device.
B. To provide a means for parameters to be passed to a MIDlets(s) without having to make changes to the JAR file.

2. Experimental

The overall implementation has been through J2ME. In implementing the dissertation work, mobile plays an important role so following specifications are required

A. More than 1 low end mobile devices is required for establishing PAN environment and those mobile devices should be enabled with Bluetooth device.
B. Low end mobile device (mobile phone) with the features like

- Mobile device should be Java enabled mobile phone.
- It should contain Bluetooth device for establishing connection with the devices in PAN.
- A camera to capture image or record videos.
- It should work with MIDlet and hold up MIDP2.0 and JAR files.
- The screen-size should be of at least 96 pixels wide and 54 pixel high.
- The screen must bear at least two colors.
- Pixel shape (aspect ratio) should be approximately 1:1
- Input is provided to the system through user input mechanism like keyboard.
- It should contain memory of 256 kilobytes of non-volatile memory for the MIDP implementation and 128 kilobytes of volatile memory for the Java runtime (e.g. the Java heap) and mobile should have ability to play tones.

We have tested this design on Nokia Series40 mobile phones. The design consists of various types of module. Before moving to modules let us see the circumstances which give rise to the concept annotation.

2.1 Circumstances which give rise to annotation process

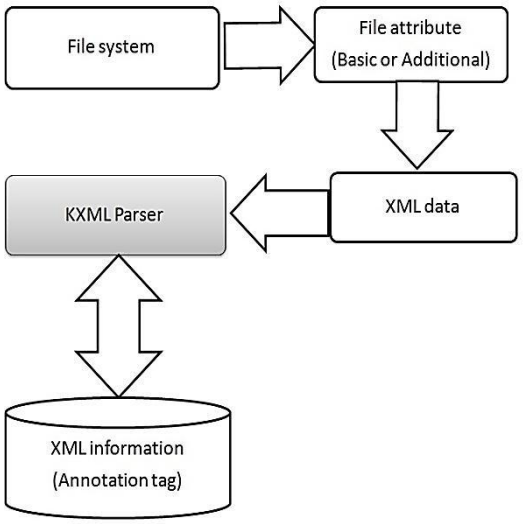

Fig. 3: Annotation process for files

Consider the situation in which, a group of people went for picnic, where users used their mobile phone camera to capture some interesting images. The images got stored with the default name like image515, image516, and so on. When the user tries to view images after few years, he can neither recall nor can he remember such names. Even he forgets how many users captured images on the picnic day. So to organize and browse such images quickly, we have introduced fig. 3 annotation process for files with their basic attributes or additional attributes. Basic attributes are extracted automatically from the underlying file system or additional attributes are manually added by user for annotation (metadata) to corresponding file and are stored in XML data format. The XML data uses kXML parser for creating light weight processes and storing XML data in XML information. XML information

consists of annotation tag (metadata). With the help of these metadata, images can be effectively searched and retrieved either from our mobile phone itself or from other user mobile phone available in PAN environment. Following are the implemented annotation processes used in our dissertation.

Fig. 4: Annotation main menu

Fig. 5: File browser

Fig.6: File annotations with Basic attribute.

Fig.7: File annotations with Additional attribute.

Fig.8: Updated Metadata

Fig.9: Advance Search Menu

Fig.10: Advance Search with keyword

Fig. 11: Result of file search using keyword

Fig.12: File Display as per search

Fig. 13: Advance Search in PAN

2.1.1 Annotation module with basic attribute

This module relate with the basic attributes of the multimedia file like

A. Name of the file.
B. Size of the file.
C. Date of creation.

Following are the steps while annotating files with basic attribute.

- Select annotate files option form main window as shown in fig. 4
- Browse the drives and folder then select the file which is to be annotated as shown in fig. 5
- When file is selected, the basic attribute (file name, file size, modified date) of a file have been extracted automatically from the file system of the low end mobile phones as shown in fig. 6.
- On clicking annotate in fig. 6, the file will be annotated and we can view the annotated file by select "updated Metadata" from the main menu window. It is viewed as shown in fig. 8

Maybe now the user can remember the date when he went to picnic. So he can perform search operation with the date attributes, he will get many files with same date. But he won't single of his interest so we have introduced annotation module with some additional attribute.

2.1.2 Annotation module with additional attribute

This module relates with additional attributes which are added to multimedia files like

A. Keyword hint for file
B. Description of file

These attribute are optional which are used to annotate the multimedia file. We can even annotate the files without adding additional attribute so it is known as optional attribute. When the image file is annotated with keyword or description, the user can remember it and he can easily recall it. So he can perform search operation using those additional attribute and get desired file. For example if the user has annotated the image with keyword "sunflower" as shown in fig. 7. When he does search with same keyword, he will get the same file for which he was searching.

2.1.3 Advance Search module in local device

The search module in local device means searching for a multimedia file within mobile phone itself. The search module is an important part which uses KXML parser to store information in XML format. Now the file can be searched from stored xml information and retrieved to user.

Following are the steps while performing advance search.

- Select advance search option form main window options as shown in fig. 4.
- Search files based upon anyone file attributes as shown in fig. 9
- Once the file search is performed for e.g. based upon file keyword like "sunflower" as shown in fig. 10
- The corresponding search result is retrieved as shown in fig. 11 and the retrieved file is displayed in fig. 12.

As discussed earlier annotation may be done either by extracting basic attribute or by additional attributes. The search operation is performed only on the annotated files.

2.1.4 Search module in PAN environment

Atleast by 2 mobile phones are required to establish PAN environment in this module. The search module in PAN environment plays an important role in finding the particular file of interest from other mobile which are present in PAN environment. In this the search operation is performed on stored xml information of mobile phone present in PAN, if only if the metadata about file is present in xml information then the file is retrieved.

Following are the steps used in this module:

- From fig.10 choose the option tab from "advance search with keyword" then "Search PAN" option is displayed as shown in fig. 13.
- Once "Search PAN" option is selected, the designed model scans the PAN environment for active mobile phone with help of Bluetooth.
- Establish the connection with active mobile phone in PAN and search operation is performed on it and file is retrieved on users mobile.

Now the user can also remember anyone file attribute of image and by recalling them, he can search and retrieve files from PAN environment unknown of how many people captured images with their camera phones on the picnic day.

3. Results and Discussion

The table 1 shows search performance for a file present local device (mobile phone itself) or in PAN environment. For this purpose we have collectively used 40 test cases in order to find out effectiveness of can file search operation in all 4 categories. We found that, search operation is performed better if the file is annotated with additional attributes. In our implementation we got higher success rate in local, as the files have been annotated with additional attributes.

3.1 Search performance with basic attribute

The success rate of getting file by search operation is higher in local as compared with PAN as shown in table 1. In this the search operation uses basic attribute to find a particular file. In our implementation, file has been searched quickly, when search operation is done on mobile device itself than in PAN environment.

Table 1 Success and Failure test cases in annotation process

S.No.	Search Performance	No. of test cases	Success	Failure
i.	In Local with basic attribute.	40	23	17
ii.	In PAN with basic attribute.	40	16	24
iii.	In local with additional attribute	40	36	4
iv.	In PAN with additional attribute.	40	33	7

3.2 Search performance with additional attribute

The success rate in this is higher than previous type i.e. "Search performance with basic attribute". In our implementation we have added additional attributes to the file, in order to perform search operation efficiently. Eventually the search performance in local is higher i.e. when the file is searched with any additional file attribute as shown in figure14.

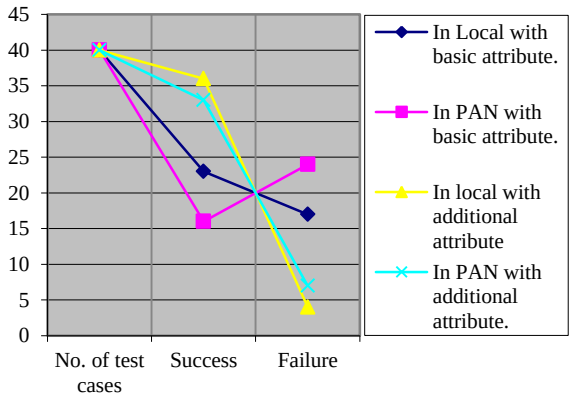

Fig 14: success and failure comparison of test cases

Conclusions

The designed model for low end mobile phone automatically extracted the multimedia file attributes from underlying operating system and uses them as a metadata to the resultant file. By using metadata, annotations to files are improved the performance to add effective search and

retrieval mechanism on the files present either in mobile device itself or in Personal Area Network (PAN).

Future work

The future work may lead us to implement the current design of "Searching and Retrieval of multimedia files with Annotation on low end mobile devices" in android (operating system) based mobile phones with concept of ontology and perform searching and retrieving techniques for files present in android phone or in PAN environment. The idea of making current design platform independent at high end mobile devices also contributes to future work.

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Author's Information

Mr. Darshan P Pandit received B.E degree in Computer Science & Engineering in 2011 from JNTU University, Hyderabad, India and pursuing the M. E. degree in Computer Science and Engineering in Walchand Institute of Technology, Solapur, India. He is doing his dissertation work under the guidance of Mr.Lobo L.M.R.J, Associate Professor & Head, Department of IT, Walchand Institute of Technology, Solapur, Maharashtra, India.

Mr. Lobo L.M.R.J received the B.E degree in Computer Engineering in 1989 from Shivaji University, Kolhapur, India and M. Tech degree in Computer and Information Technology in 1997 from IIT, Kharagpur, India. He is registered for Ph.D in Computer Science and Engineering at SGGS, Nanded of Sant Ramanand Teerth Marathawada University, Nanded, India. Under the guidance of Dr. R.S. Bichkar. He is presently working as an Associate Professor & Head, Department of IT Walchand Institute of Technology, Solapur, Maharashtra, India. His research interests include Evolutionary Computation, Genetic Algorithms and Data Mining.