Content-based Multimedia Management For Mobile Devices

Iftikhar Ahmad
Outline

• Introduction
• Mobile Multimedia Video Indexing and Retrieval System (M-MUVIS)
  – Content-based image and video management for mobile devices
  – Content-based Audio management for mobile devices
• Java Server Pages (JSP-MUVIS): CBMM for XHTML enabled mobile devices
• On device multimedia content-based management
• Conclusions
Introduction (1/2): creation

- Painting
- Pictures
- Digital cameras
- Mobile phones with camera
- Security cameras
- Gigabit cameras
- “Multimedia Services in Intelligent Environments”, Chapter 8.
Introduction (2/2): Usages

• Pictures
  – Albums

• Multimedia contents
  – Personal
  – Family
  – Community
  – Public
Multimedia Content Management (1/2)

- Photo Albums
- Personal Videos (VCR etc.)
- Digital Contents (images/audios/videos)
- Sharing on Internet/network
- Multimedia Phone (MMS/Emails)
- Meta-Data for Multimedia Management
- Content-based Retrieval
Multimedia Content Management (2/2)

- Create/Get
  - Digital cameras/Internet
- Edit
  - Picasa, etc.
- Organize
  - Picasa, etc.
- Share
  - Flicker, etc.
- Consume
Content-based Multimedia Management

• Content-based management
  – Color
  – Texture
  – Shape
  – Object (part of a shape)
  – Etc.
CBMM And Multimedia Computers
Edit, Organize and Share

- Nokia Share OnLine
- Mobile Web server
- Apple iLife09
- Flicker
- KODAK EASYSHARE
- Photobucket
- Picasa from Google
- Others: AOL Pictures, Atpic, Fotki, Imageshack, ipernity, Jalbum, Piczo.com, Phanfare, SmugMug, Snapfish, Shutterfly, Webshots, Woophy, Zooomr and etc.
Retrieval by Features

Visual

Audio

25–March-2009 CBMM for Mobile Devices
Text-based Search (1/4)

- Google search
- WidSets
- MUPE
- Yahoo Go
- Google gmap, blogger, calendar etc.
- Nokia search
- Gypsii
- MS-live search
- T9 Nav
Lifeblog: Text-based Search (2/4)

• Organize images, audio, video, MMS, SMS etc.
Microsoft: Text-based Search (3/4)

- MyLifeBits Project
  - online life archive
- Social Information Retrieval
  - Adapt to user activities
- Personal content management
Others: Text-based Search (4/4)

- http://www.myfoodphone.com/
- http://www.nutrax.com/
- http://www.recordmycall.co.uk/
- http://www.edv.uk.com/
- http://www.scoopt.com/
Content-based Multimedia Management

• Internet (Client-Server) based Management
  – Mobile MUVIS (MMUVIS)
  – Java Server Page MUVIS (JspMUVIS)

• On Device Management
  – Feature extraction and stored
  – Query is performed
Content-based Multimedia retrieval for mobile Device (CMD)

CMD Clients
- M-MUVIS Client
- JspMUVIS Client

CMD Server
- Query Engine
  - Event Manager
  - Query Result Manager
- Native Library
- Database

M-MUVIS
- MQS
- MMRS

JspMUVIS
- Query Processing
- Mobile Device Profile
- Media Retrieval

PC
- XHTML
- HTML

XHTML
HTML

25–March-2009 CBMM for Mobile Devices
Mobile Multimedia Video Indexing and Retrieval System (M-MUVIS)
Mobile-MUVIS Framework

- Query Engine
  - Feature Extraction
  - Similarity Measurement
  - Features

- MQS
  - Media Items
  - Query item
  - Session
  - Best Matches

- Clients
  - Display Results
  - MMRS
  - Image Query

- Server
  - Other Sources (PC)
  - On-line Processing
  - Off-line Processing

- Multimedia Database
  - Features
M-MUVIS Client Mobile Devices

Start Query from Menu

http://muvis.cs.tut.fi
ifftikhar.ahmed@tut.fi

Options Close Options Close

Random Query

Retrieving query resultant Image

OK

MMUVIS

Enable NO

Sub query Result No

Sub Query Time

Result Image Quality

Thumb Image Width

Thumb Image Height

Mark

Back

MMUVIS

Start Query from Menu

http://muvis.cs.tut.fi
ifftikhar.ahmed@tut.fi

Wait for query results

Retrieving query results...

OK

MMUVIS

Start Query from Menu

http://muvis.cs.tut.fi
ifftikhar.ahmed@tut.fi

25–March-2009

CBMM for Mobile Devices
M-MUVIS Client Architecture

Engine
- Command Handler
- Image Media Control
- Query Information
- Network Connection

User Interface
- UI Manager
- Abstract UI
- Image Canvas
- Image Capture
- Utility classes (String handling/Localization)

Setting
Interactive Query

Session

MMR

MQS

Query Information

HTTP

25–March-2009

CBMM for Mobile Devices
M-MUVIS Setting on 9500

A

Enable/Disable IQ

M-MUVIS Setting

B

Enable NQ

Sub Query Result No 4

Sub Query Time 10000

Query Result Image Quality 25 / 100

Thumb Image Width 220

Thumb Image Height 120

C

Thumb Image Height 120

Thumb ImageGap X 5

Thumb ImageGap Y 5

Select Query Type

Image Query

Video Query

Audio Query

D

Actions Edit

Update

Back

Exit Ctrl+E

Select Query Type

Image Query

Video Query

Audio Query

Back

Cancel

25–March-2009 CBMM for Mobile Devices
M-MUVIS Client Setting
Hierarchical Cellular Tree (HCT)
Describing media items in HCT

Level 0 = Ground Level
Level 1
Level 2 = Top Level

Query Item: PQ operation

Yellow
Red
Blue
Security
M-MUVIS Client, Image Query on N90

Start Query from Menu

http://muvis.cs.tut.fi
iftikhar.ahmed@tut.fi

Options  EXIT
Image Query in Image Database (1/3)

Start Query from Menu

Random Query
M-MUVIS Setting
Camera
Show Log
Exit

Select
Cancel

Random Query

Retrieving query resultant Image

Options  Close

Options  Close

Options  Close

Options  Close

Options  Close

Options  Close

http://muvis.cs.tut.fi
iftikhar.ahmed@tut.fi

25–March-2009  CBMM for Mobile Devices
Image Query in Image Database (2/3)

Start Query from Menu

http://muvis.cs.tut.fi
iftikhar.ahmed@tut.fi

Options EXIT Update Back

Thumb Image Width 100
Thumb Image Height 100
Thumb ImageGap X 05

Wait for query results
Query by Name

Options EXIT Update Back

Wait for query results
Retrieving query resultant Image

CBMM for Mobile Devices
Image Query in Image Database (3/3)

A. Start Query from Menu

http://muvis.cs.tut.fi
iftikhar.ahmed@tut.fi

B. M-MUVIS Setting

Enable NQ
Sub Query Result No: 1
Sub Query Time: 800
Query Result Image Quality: 25 / 100
Thumb Image Width: 120
Thumb Image Height: 120

C. Query image

D. Matched images

25–March-2009

CBMM for Mobile Devices
Query Resultant Image on Server Side for 9500

11 best matched retrieved images
# Statistics: Image Query in Image Database (1/2)

<table>
<thead>
<tr>
<th>Network</th>
<th>IQ CQT</th>
<th>IQ SD</th>
<th>NQ CQT</th>
<th>NQ SD</th>
<th>NQ Mean (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,000 image database</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6630 (3G)</td>
<td>1,442</td>
<td>334</td>
<td>114</td>
<td>7</td>
<td>1,401</td>
</tr>
<tr>
<td>9500 (Edge)</td>
<td>2,977</td>
<td>435</td>
<td>110</td>
<td>9</td>
<td>3,101</td>
</tr>
<tr>
<td>9500 (WLAN)</td>
<td>467</td>
<td>51</td>
<td>86</td>
<td>8</td>
<td>690</td>
</tr>
<tr>
<td>10,000 image database</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6630 (3G)</td>
<td>2,687</td>
<td>816</td>
<td>1,792</td>
<td>41</td>
<td>9,797</td>
</tr>
<tr>
<td>9500 (Edge)</td>
<td>6,417</td>
<td>1,010</td>
<td>2,102</td>
<td>37</td>
<td>9,828</td>
</tr>
<tr>
<td>9500 (WLAN)</td>
<td>1,020</td>
<td>452</td>
<td>2,091</td>
<td>50</td>
<td>6,515</td>
</tr>
</tbody>
</table>
## Statistics: Image Query in Image Database (2/2)

<table>
<thead>
<tr>
<th>Networks</th>
<th>IQ CQT</th>
<th>SD (ms)</th>
<th>IQ SQT</th>
<th>SD (ms)</th>
<th>NQ CQT</th>
<th>Mean (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>30,000 image database</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6630 (3G)</td>
<td>5,368</td>
<td>2,899</td>
<td>3,321</td>
<td>284</td>
<td>98,625</td>
<td></td>
</tr>
<tr>
<td>9500 (Edge)</td>
<td>9,574</td>
<td>1,646</td>
<td>6,151</td>
<td>10</td>
<td>100,688</td>
<td></td>
</tr>
<tr>
<td>9500 (WLAN)</td>
<td>5,726</td>
<td>660</td>
<td>4,520</td>
<td>148</td>
<td>96,844</td>
<td></td>
</tr>
<tr>
<td><strong>60,000 image database</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6630 (3G)</td>
<td>6,421</td>
<td>640</td>
<td>5,160</td>
<td>10</td>
<td>411,094</td>
<td></td>
</tr>
<tr>
<td>9500 (Edge)</td>
<td>9,931</td>
<td>602</td>
<td>5,285</td>
<td>8</td>
<td>422,365</td>
<td></td>
</tr>
<tr>
<td>9500 (WLAN)</td>
<td>5,831</td>
<td>590</td>
<td>4,932</td>
<td>7</td>
<td>415,032</td>
<td></td>
</tr>
</tbody>
</table>
Content-based Audio Management for Mobile Devices
M-MUVIS Client Audio Query

25-March-2009

CBMM for Mobile Devices
Visual and Audio Query Resultant Image
Created on the Server Side

A) Shows the visual query results
B) Shows the audio query results
## Statistics: Audio Query in Video Database

<table>
<thead>
<tr>
<th>Networks</th>
<th>IQ</th>
<th></th>
<th>NQ</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CQT (ms)</td>
<td>SQT (ms)</td>
<td>CQT (ms)</td>
<td>SQT (ms)</td>
</tr>
<tr>
<td>6630 (3G)</td>
<td>6,777</td>
<td>949</td>
<td>5,578</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>297,385</td>
<td>3955</td>
<td>290,465</td>
<td>344</td>
</tr>
<tr>
<td>9500 (WLAN)</td>
<td>5,609</td>
<td>104</td>
<td>5,005</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>290,281</td>
<td>352</td>
<td>289,654</td>
<td>306</td>
</tr>
</tbody>
</table>
JSP for Mobile Devices
Non-MIDP Devices
JspMuvis

Client/Server Communication

Connected Mobile Devices

XHTML Interface

HTML Interface

PC

JspMuvis Server Engine

Query Processing

Generating thumbnails

Client Session maintenance

Device Profile

Query Engine

Event Manager

Query Result Manager

Native Library

Database

25–March-2009

CBMM for Mobile Devices
JspMU VIS (2)

Time

Connect

Create session, generate and send query input form

Submit query request

Perform the query operation, save the results in session, generate and send QRI
JspMuvis on 6630
On Device Multimedia Management

- On device feature extraction
- Database creation
- On device query operation
Conclusions
Conclusions (1/3)

• Due to the limitation on the mobile platforms client-server architecture is the most suitable solution for content-based query operation.
• Server can implement different algorithms for efficient content-based media retrieval without any change on the client’s implementation.
• Additionally server can add watermarking for identification in the retrieved media items.
Conclusions (2/3)

- IQ helps to make the system responsive during the query operation in larger databases.
- Early access to query results due to IQ over HCT.
- IQ reduces the system requirements (RAM processing power) on the server side.
- Although IQ increase the network traffic (client might download many intermediate results).
Conclusions (3/3)

• Not all the devices support Java.
• Browser partly handle the presentation layer.
• A lot of XHTML tag data in query results as HTML pages increase the network delays.
• XHTML browser on mobile device implement limited number of features. It is hard to provide many functionality (popup-menu etc).
• XHTML browser consumes significant amount of device memory (due to loading of many protocols).
Future Work (1/2)

• On Device feature extraction and query operation
• Reduce the client-server communication in M-MUVIS and JSPMUVIS.
• Better user interface adaptation on the M-MUVIS and JSPMUVIS.
Future Work (2/2)

• Content-based browsing in indexed such as HCT database in M-MUVIS and JSPMUVIS.
• Relevance feedback for the content-based query operation in M-MUVIS.
Comments/Suggestion/Questions
Links (1/3)

• Gigabit camera
  – http://spie.org/x23645.xml?ArticleID=x23645

• Forum Nokia: Devices list
  – http://www.forum.nokia.com/devices/matrix_all_1.html

• Java 2 Micro Edition soft Library
  – https://lwuit.dev.java.net/nonav/tutorial/index.html

• http://dev.widsets.com/
Links (2/3)

• http://www.v-enable.com/411/index.html

• Supported Multimedia
  – http://www.forum.nokia.com/Resources_and_Information/Explore/Mobile_Design_Centre/Mobile_Multimedia.xhtml

• Java IDE
  – http://www.eclipse.org/
  – http://www.netbeans.org/
Links (3/3)

• Java Applications
  – http://mobile.yahoo.com/?refer=1GFXLX
  – http://m.google.com

• Kodak easy share

• http://www.kodak.com/eknec/PageQuerier.jhtml?pq-path=130&pq-locale=en_US&_requestid=3759

• http://picasa.google.com

• http://photobucket.com