모바일 폰 기반의 사이버 자연사 박물관

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Cyber Natural History Museum Contents for Mobile Phones

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A B S T R A C T

These days' mobile phones and their improved multimedia limits making it powerful enough to handle complicated tasks. Image processing related support for mobile devices is extremely comprehensive in mobile cyber museum. A key technical challenge is how to achieve the best-perceived image quality and transmitting data between client and server with given the limited screen size and display bit-depth of the mobile devices. This paper targets image processing features such as capturing rendering zooming, panning and image rotation for 360o view and customized algorithm related image processing with variety of search method i.e. alphabetical, visual search.

***Keywords*— Cyber Natural History Museum, Image Processing, Mobile Museum, J2ME MMAPI and AMS**

1. Introduction

Mobile Cyber Museum of Natural History is defined as the use of audio video, and other telecommunications and electronic information processing technologies for the transmission of information and data relevant to the shells and fossils. Most museum studies emphasize that museums are the ideal places for preserving, exhibiting, depicting, classifying, enriching and valuing antiquities. However, in most cases, cyber natural history museum confine its attention to shells and fossils as intangible heritage. A challenge for the students today is to make sense of the heaps of information and data available to them and to embrace a significant attitude to it. Students therefore need to know what to search for, how and where. Museums provide a unique interactive experience of getting up close to things. Museums are extremely valuable source of creativity, and get to know and learn about them. The Cyber Natural History Museums emphasizes the significant role of museums, with the aim of serving them with knowledge on shells and fossils that one cannot find in their text books and at schools and providing them quick access to expert during their field research, by capturing the findings and uploading them to server for correct info and detailed knowledge about them from experts. Cyber Natural History Museums is for academic, educational and entertainment purposes. The role of cyber natural history museums in general, in particular, in raising children awareness of the importance of intangible heritage through material proofs.

2. Mobile Cyber Museum Design and Implementation

Generally speaking, there are three key roles in a generic cyber museum of natural history process as shown in Figure1.

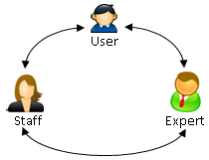

Figure1: Basic Mobile Cyber System Process.

The user is in focus of Korean shells and during his field work came across a strange shell never seen before he took a picture of it and send to cyber museum staff for detailed information on it. Cyber Museum staff sort out and forward that request (query) to expert who deals with shells and send back notification to user. Expert(s) open the query and sends back reply. Administrator (Staff) is responsible for query routing and assigning expert(s) via web interface. The experts have the overall responsibility for updating queries. Cyber museum's database can be accessed in different methods such as alphabetical or visual search (search by shapes) and a 360^{o} display window letting user control the image rotation speed (slow, fast, pause and start) with basic info on selected item and a link to detail information as show in Figure2.

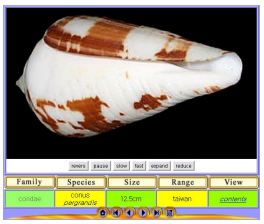

Figure2: main display window of cyber museum

3. Design

A software development methodology is a framework in software engineering, by using which we can structure, plan, and control the process of developing an information system [7]. The ideas behind designing a mobile cyber museum

system, including data structures, system architecture and protocols used in communication over the IMS network are described.

3.1 User interface

The user interface of this cyber museum system is very important, especially on the client side. The mobile client is meant to be used by user of any age and don't have to have ideas about how the system works behind the screen; they only interact with the user interface. Therefore it is kept simple, straight, and intuitive to use.

Figure3: Cyber Museum User interface

Figure3.1 to 3.5 shows the client UI, creating new query with or without attachments/recipient (experts).

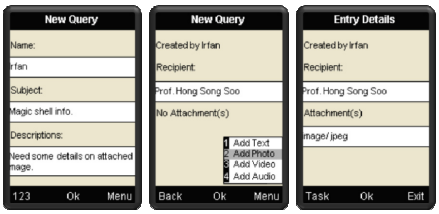

Figure3.1 Figure3.2 Figure3.3

Figure3.1: "New Query" where user can create new entry.
Figure3.2: New Query sub screen where user can mention the name of recipient (expert) and add extra data (attachment).
Figure3.3: Screen where shows attachment information such as (text, photo, video or audio file) related to query.

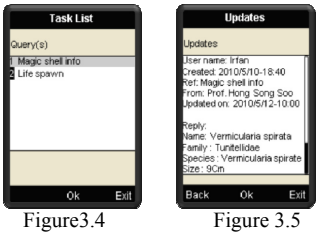

Figure3.4 Figure 3.5

Figure3.4: Task list screen, the list of all entry created (query).
Figure3.5: Screen where user can see reply on his/her query from recipient like (name, family, species, size and

3.2 Data Structure

The main data in the cyber museum system is the detailed information and images. The information data can be expressed by such a concept called "Query". Query is a way to sort out and distinguish various questions in research fields. Each and every field (shells and fossils) can have several informatics data. One or more entries forms a Query and those entries establish a data history.

A and B are two entries defined by the index letter and number, from number one to five, specifies an entry in time, and the colour tells the data type of an attachment, such as photo or video as shown in Figure5. Following is a sequential order of Query A.

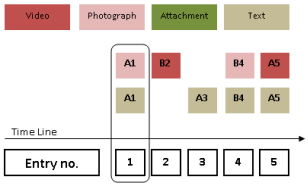

Figure5: Concept of query and entry

Entry 1: The user's first visit with a photo as attachment, sent to the experts together with a written question as text.
Entry 3: A response from experts on question A1 in the form of plain text.
Entry 5: Another user visit, documented with a video, sent to expert for further details.

In the Figure6 there is user called Taylor has two ongoing queries. Every query is documented by different entries identified and sorted by the timestamp, while each entry consists of text, photo, video or audio and has a number of recipients or none.

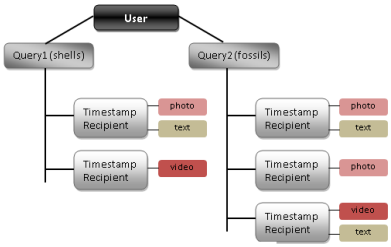

Figure6: Example of cases and entries.

In the requirements of this mobile cyber museum system, the word "task" is mentioned. A task stands for a question that has to be answered by a experts or staff with certain time constraint. Furthermore, a task can be categorized into two kinds as in Figure7. One is query on shells, which is a scheduled query from users. The other is a so called query update, and it can be a notification of any change in a shell query of a user.

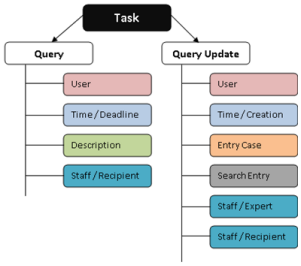

Figure7: Concept of Task

3.3 Architecture

The overall architecture of the cyber museum system is built upon several entities as shown in figure8. IMS core network is the most complex entity and it handles SIP messing and routing, enabling the communication between client and server.

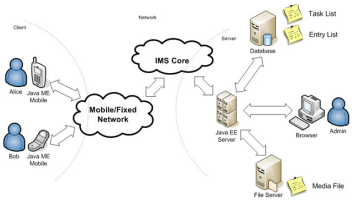

Figure8: Architecture of mobile cyber museum system.

The mobile cyber museum system adopts the well known and widely used three-layer [6] architecture on both client and server side. In the scope of mobile cyber museum of national history system, all operations related to resources, are defines by the service layer. The data access layer interacts with persistent data stored in a database, in this case, MySQL on the server side, or in permanent storage, record store in mobile.

3.4 Protocols

In this mobile cyber museum system, there are three main protocols defining the communication between each mobile client and the servers, which are client start-up, Query Assignment and search entry.

3.4.1 Client Startup

The first protocol is the retrieve of daily updates for requested queries as illustrated in Figure 10.

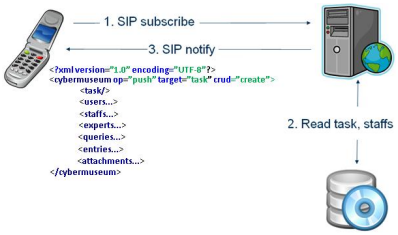

Figure10: Protocol of client startup.

- Triggers when JME client starts up.
- Registers itself in the IMS network (authentication and authorization).
- Sends a SIP subscription with a specific event header called "cybermuseum".
- Server app receives the subscription over the network.
- Puts the requesting client into the list of subscribers.
- Looks for the tasks in the database,
- Issues back a SIP notification

3.4.3 Query Database

Next, on server side, a new query is assigned to expert(s) by staff administrator. Server application pushes the created resources to the intended receiver at very next available moment as shown in Figure11.

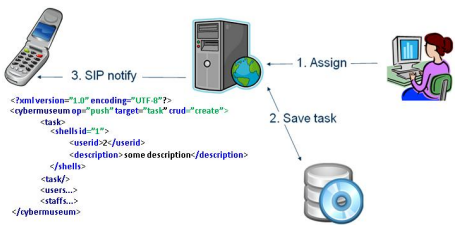

Figure11: Protocol of assigning tasks

- Server application first saves the task into the database
- Assign to expert and sends a notification with serialized task information

3.4.2 Create Entry

A query is built by appending entries to the entry case, and the entry can have recipients who check this entry at a distance, can consult and advice the user on particular query. Figure12 illustrates such protocol of documenting a new entry.

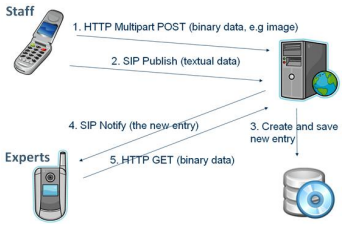

Figure12: Protocol of register new entry

- The binary data, e.g. a photo is sent to server through HTTP Multipart POST first.
- Textual description of the entry is handled to server via SIP publication right after.
- Once the server application receives the entry.
- Extracts the resources, saves the incoming entry with textural data into the database.
- The server then checks the recipients of the entry (Updates query and save automatically).
- Sends notification contains the query updates.
- The recipient can fetch the entry via HTTP GET.

The same steps may repeat iteratively until both parties reach the consensus on diagnoses

4. Image Processing

MMAPI/AMMS is the key to mobile imaging in this cyber mobile museum system, the quality of the image is an important aspect. One way is to capture/record images by using built-in program, and then from java me client access/load image(s) using JSR 75 which requires to jump between different applications and making it difficult to manage. For efficient and effortless image processing, all operations are purely done within Java together with MMAPI and its extension AMMS.

4.1 Capturing Image

MMAPI allows Java ME application to capture still images, as well as play and record sound and video clips with better controls over audio, video and image processing abilities. Even though MMAPI's *VideoControl* can take a picture, but AMMS gives better control over the way the image is taken and what is done with it. AMMS image encoding and Post Processing features are used for creating raw images and support for any kind of image format with better control over *ImageEffectControl*,*ImageTransformContro*l,*OverlayContro*l, etc. The instance of Player is created for capturing the live video with the help of built-in camera then get VideoControl for controlling the output of video, and snapshot with getSnapshot().Focus of the camera device is controlled with FocusControl interface and image is piled up in the form of a byte array and sent out to server through HTTP as a binary attachment for further transactions. Macro photography is a vital part. It is a property of the lens to focus on a subject just centimetres or even millimetres away

4.2 Image Rendering

MIDP render the whole image by Image.createImage() which burns up large amount of memory, Java ME itself and other additional libraries need memory as well. AMMS let you create a thumbnail from the bytes stream of the captured image by using *MeidaProcessor* and *ImageTransformControl*

Memory consumption for rendering image depends on its resolution. On devices like mobile phone with limited system memory and memory allocated to JVM (java virtual machine) is challenging. In Image rendering method source square of 2048*1536 pixels on the left side and target square on right as shown in Figure13 shows holder for original and resulting images. Target square changes its size according to the height and weight of the mobile screen. Target image, after transformation is the original image displayed on the screen.

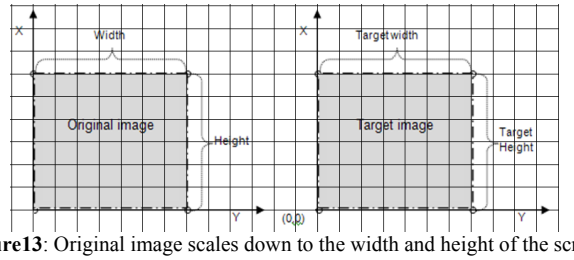

Figure13: Original image scales down to the width and height of the screen

4.3 Zooming and Panning

Rendering a picture with high resolution and fine focus on mobile phone with restricted resources is quite a challenge on mobile phone screen size. In mobile cyber museum, user takes a picture(s) shell and sends it to the staff/expert for detailed information, due to the small screen size of mobile phone it is hard to view details of image. With the help of AMMS customized algorithm is designed for zooming. Figure 14 shows the geometrical presentation of the zooming algorithm adopted in the mobile client.

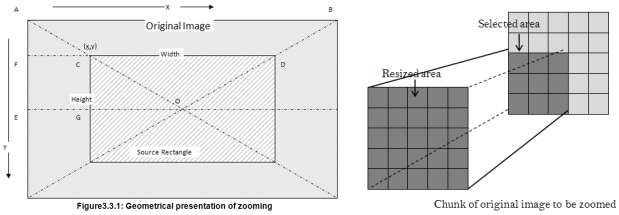

Figure14: Geometrical Presentation of Zooming

Zooming is to take a part of image and display it on the screen, more details of the image will expose. It grabs a small piece of the original image and resizes it into a new image. The coordinate of left-top corner of original image is (0,0) the X-axis is pointing from left to right, and the Y-axis is pointing from up to down. The outer box stands for the original image of size 2048*1536, whereas the inner box is the sub-part of the image to be taken from the original image. The rule is that every zoom of original image shifts the point (x, y) away from (0, 0) along the diagonal by a fix step. The distance between (0, 0) and (x, y) is called zmLnInDgnl, and the fix step is named zmStp. Every zoom produces new zmLnInDgnl which is equal to previous zmLnInDgnl plus zmSt as show in below equation Figure15, then:

$$x = \frac{originWidth \times zmLnInDgnl}{originDiagonal} \qquad y = \frac{originHeight \times zmLnInDgnl}{originDiagonal}$$

$$height = \frac{(halfDiagonal - zmLnInDgnl) \times originHeight}{halfDiagonal} \qquad width = \frac{(halfDiagonal - zmLnInDgnl) \times originWidth}{halfDiagonal}$$

Figure15: Memory required for rendering 24-bit

The sub-image is taken from the original image starting from (x, y) preserving the same ratio as the original and AMMS will help to spread out sub-image on the screen.

5. Conclusions & Future Work

This conclusion of this project is a system prototype for mobile cyber museum. The system proves the concept of building such application over IP Multimedia Subsystem, with particular focus on mobile imaging can be useful, such as in educational purpose for students and people interested in historic and cultural heritage. Following improvements of the mobile cyber natural history museum system are the next step to deal with. Client performance and resource handling on data access layer. Authentication, authorization and access control should be importance in the system, in particular the web interface. Furthermore, other IMS enabled services to be explored, such as push-to-talk (PTT) and multimedia telephony (MMTel), video conference for better interaction..

6. Proposed Mobile Cyber Museum System Prototype

Purposed Mobile Cyber Museum System details how features of natural science are being explored and introduced in naturalistic approach. It enhances the basic offline and online methods and procedures that are taken up by the users and recommend that this connective approach is useful for user/students when working in the field mobile cyber natural museum of history Table1 shows some of key features.

Search	Alphabetical Search
	Graphical Search
	Search by Shape
Museum Related Contents	Online Contents *(Search, Detailed/basic info, customized display, etc.)*
	Mobile Related Contents *(Support from experts/staff on the spot)*
Image Processing	Capturing Image
	Rendering Image
	Zooming and Panning
	Rotating Image
Network convergence	IMS (IP Multimedia Subsystem)

Table 1: features of mobile cyber museum

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