

PRELIMINARY NEW SATELLITE DATA RETRIEVAL SYSTEM ON WORLD WIDE WEB

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ABSTRACT:

Preliminary satellite data retrieval system working on WWW(World Wide Web) Internet service was implemented on workstation. Thumbnail images of appropriate size were selected and displayed on the window of the WWW browser Netscape. It was checked whether the retrieval and expanded time of those thumbnail images could be endured in practical use. The comparison of the time for the images to be expanded on the window was also done on various client machines such as SPARC workstation, Power Macintosh and Pentium Window personal computers. The results were considered to be fairly acceptable.

1. INTRODUCTION

The demand of effective retrieval system for vast satellite data has been growing year by year. The browsing system of satellite data requires much more function such as checking portion of clouds to the whole satellite image or quality of the image. Besides effective use of the retrieval system requires excellent graphical user interface and good connectivity to the World Wide Web service through Internet. Firstly, let us make a brief survey of some satellite data retrieval systems on

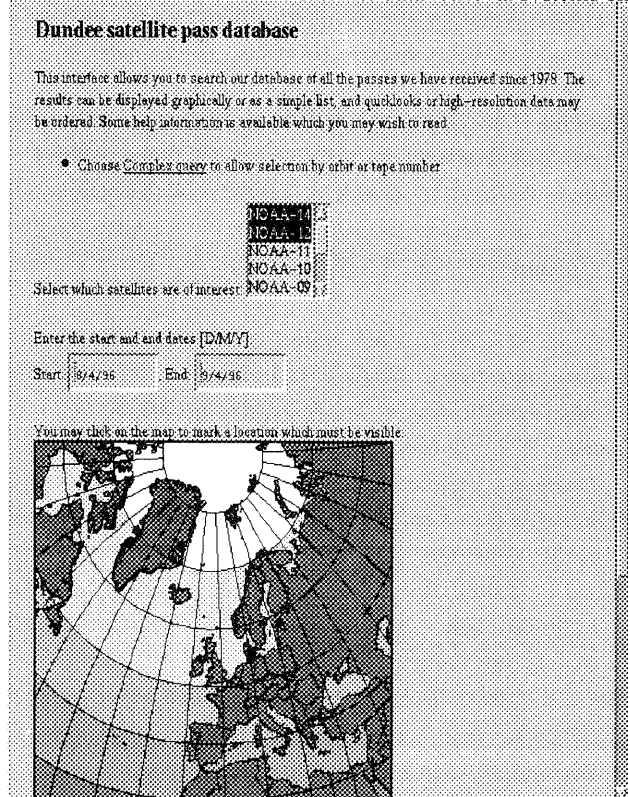


Figure 1 Dundee satellite pass database clickable map

WWW until lately. Typical four sites on WWW are introduced as follows.

1) Dundee satellite pass database (<http://www.sat.dundee.ac.uk/bin/pass/>)

This database system allows us to search NOAA's quicklooks or high-resolution data of all passes they received since 1978 at Natural Environment Research Council. Clickable map of Europe is available as in Figure 1.

2) CCRS Satellite Imagery Catalogue System (http://www.ccrs.nrcan.gc.ca/gcnet/query/query_e.html)

CCRS Satellite Imagery Catalogue System

The table below shows the various "collections" of satellite imagery data archived at the Canada Centre for Remote Sensing. For each collection, the availability of the following services is indicated: "Quicklook Images", "Inventory", "Order Desk" and "Satellite Data User's Guide". Please click on the appropriate table cell to invoke the corresponding service.

Please note that you need Netscape Version 1.1N or higher to access the on-line Quicklook images.

Collection	Quicklook Images	Inventory Data	Order Desk	Satellite Data User's Guide
LANDSAT / TM	YES	YES	RSI	NO
SPOT / PLA & MLA	YES	YES	RSI	NO
LANDSAT / MSS	NO	YES	RSI	NO
ERS / SAR	NO	YES	RSI	NO
NOAA / AVHRR				
- Raw Data	YES	YES	CCRS	YES
- Geocoded & Composite	NO	YES	MRSC	
MOS / MESSR	NO	YES	CCRS	NO
JERS-1 / SAR & OPS	NO	YES	CCRS	NO
SEASAT / SAR	NO	YES	CCRS	NO

► **How to enhance the quicklooks contrast.**

Figure 2 CCRS Satellite Imagery Catalogue System

www.ccrs.nrcan.gc.ca/gcnet/query/query_e.html

Satellite images are various collections of data archived at the Canada Centre for Remote Sensing. Items offered by this system are quicklook images, inventory, order desk and satellite data user's guide. Quicklook images are presented for

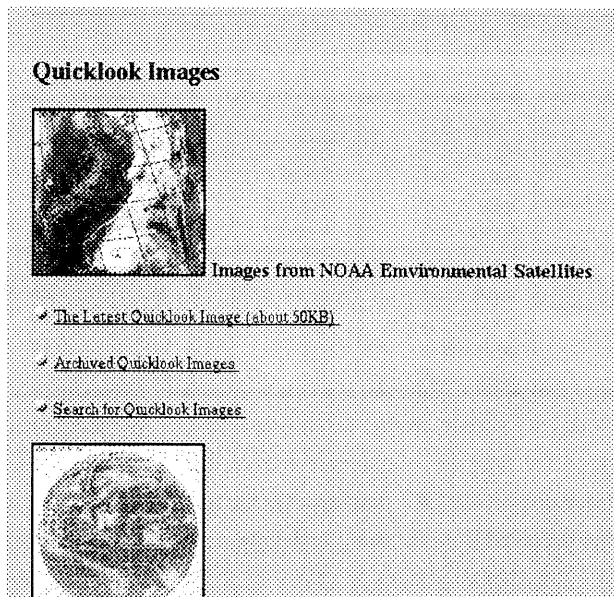


Figure 3 Home page of the site for search for Quicklook images

LANDSAT/TM, SPOT/PLA & MLA, and NOAA/AVHRR. Figure 2 shows one of the WWW pages at CCRS catalogue system.

3) satellite images and news (<http://www.tkl.iis.u-tokyo.ac.jp/SatIAN/Welcome.html>)

Quicklook images from NOAA environmental satellites are archived for over about decade. Retrieval conditions for the

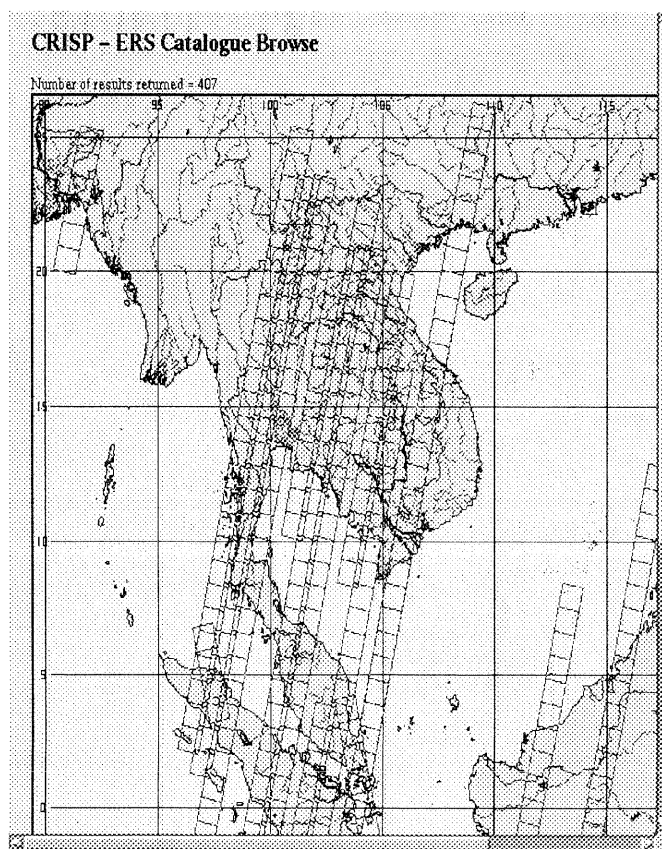


Figure 4 CRISP-ERS catalogue browse over Indochina area

quicklook images include area, season, time and so forth. Figure 3 shows a home page of this site on WWW.

4) CRISP-ERS Catalogue Browse (<http://www.crisp.nus.sg/crisp.html>)

Satellite images from SPOT and ERS over Indochina peninsula area are offered by Centre for Remote Imaging, Sensing and Processing National University of Singapore. About four hundred ERS scenes are catalogued and clickable image map for browsing ERS data is available. Figure 4 shows CRISP-ERS catalogue browse over Indochina area.

Although above some satellite data catalogue systems have advantages in search of required data, respectively, it seems to be better to have a feature that plural thumbnail images which match the retrieval condition can be displayed on the window at the same time. Besides the linkage of the retrieval system to database management system might be required for more powerful and effective search of vast satellite data. We'll discuss features of our proposed satellite data retrieval system in the next section.

2. PROPOSED SATELLITE DATA RETRIEVAL SYSTEM

Some features such as an excellent graphical user interface and good connectivity to the WWW service through Internet are essential to the retrieval system for end-users. The excel-

Table 1 Premise amount of thumbnail and detailed images from ASTER

Sensor type	Original Images	Thumbnail Images	Detailed Images
VNIR (777scene/day)	4100 x 4200 x 4B	136 x 140 x 3C	273 x 280 x 3C
SWIR (777scene/day)	2048 x 2100 x 6B	128 x 131 x 3C x 2S	256 x 262 x 3C x 2S
TIR (1554scene/day)	708 x 700 x 5B	141 x 140 x 3C x 2S	236 x 233 x 3C x 2S

C: Channels S: Scenes

lency in operation of the retrieval can be achieved by adopting the present prevailed WWW browser technique. To make appropriate and reduced thumbnail images out of vast digital satellite data plays an important role in construction of the better retrieval system. Let us estimate approximate data size of thumbnail and detailed images which will be received from ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) which is supposed to be launched in 1998. Table 1 shows the premise amount of thumbnail and detailed images from ASTER. The size of thumbnail and detailed images are estimated by considering the displayed size of those images on end-users's CRT display of the computer. The size of 140x140[pixels*lines] for thumbnail images is appropriate for checking the quality of original satellite data

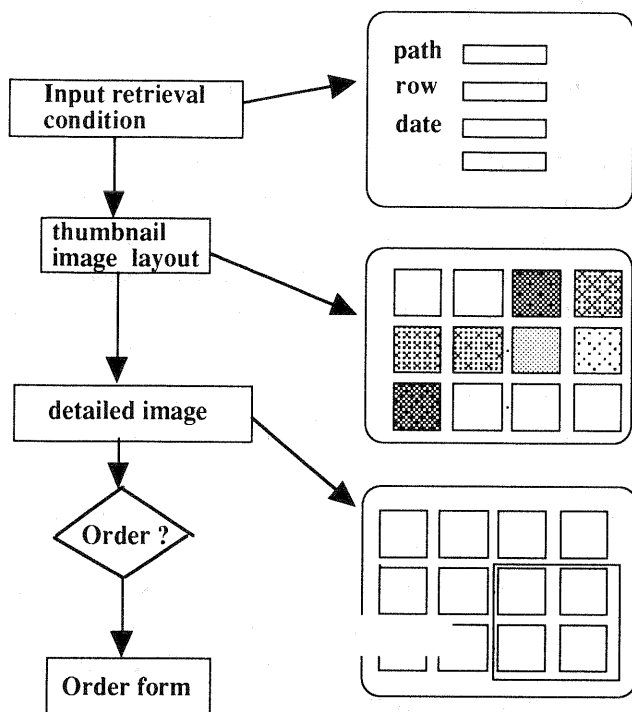


Figure 5 Simple flow chart of the proposed retrieval system for end-users

since this size of images reflects 30mmx30mm square on the 17-inch CRT display. The detailed images become four times in area as much as the thumbnail images, i.e. 60mmx60mm square on the screen. We have examined two methods of preparing the thumbnail images from original raw satellite data. One is to extract the thumbnail image by adequate sampling from raw data. And the other is to utilize a certain index of band ratio of digital satellite band values to make semi-automated classified image as an index image.

Figure 5 shows the simple flow chart of the proposed retrieval system for end-users. After the entry of the retrieval condition which the end-user requires, the returned results from the database engine will be displayed on the window of the client machine as the layout of the thumbnail images. End-user then can select and click a certain thumbnail image to get a detailed image on another window. If the end-user wishes to order the original satellite digital data from the layout of the thumbnail images, another window for order form will be opened. We have constructed the WWW server on SPARC workstation using CERN and/or NCSA httpd. To realize the function as in the above flow chart, we have adopted the CGI(common gateway interface) function on the WWW server and the commercial extended RDBMS(relational database management system), G-BASE. The retrieval system demands the very high performance of pre-processing original satellite data and the practical time-performance for the retrieval under the effective database management system. The influence of the net-

Table 2 Measured real time for displayed images on various client machines

	client machine	network load hops (round-trip time)	displayed images	
			thumbnail images real time[sec]	detailed images real time[sec]
out of segment	Sparc10 (a)	9 (40ms)	23.39	8.9
	Sparc20 (b)	10 (650ms)	41.1	18.19
	Sparc10 (c)	10 (50ms)	24.9	10.01
within segment	sparc2 (d)	-	6.35	1.69
	sparc20 (e)	-	2.09	0.8
	Macintosh (PowerPC)	-	8.66	1.64
	DOS/V(Win95)	-	2.15	0.76
	DOS/V (Win3.1)	-	10.97	2.36

work load should also be taken into account. We have measured the time for thumbnail images to be transmitted and expanded on the CRT display after the results of the retrieval was received from the satellite database. The size of the sum of 12 thumbnail images is 124KB in JPEG graphic data format, and the size of one detailed image is 27KB. The measurement of time was performed on two different network environment, that is, out of the same LAN segment and within the same segment. The measured time is the average of 30 times measured values on each client machine. The comparison of the measured time and the network environment of various client machines is listed in Table 2. Real time denotes the time measured by stopwatch for the duration from the moment of entering the input data to that of being received results. Network load is figured by the results from

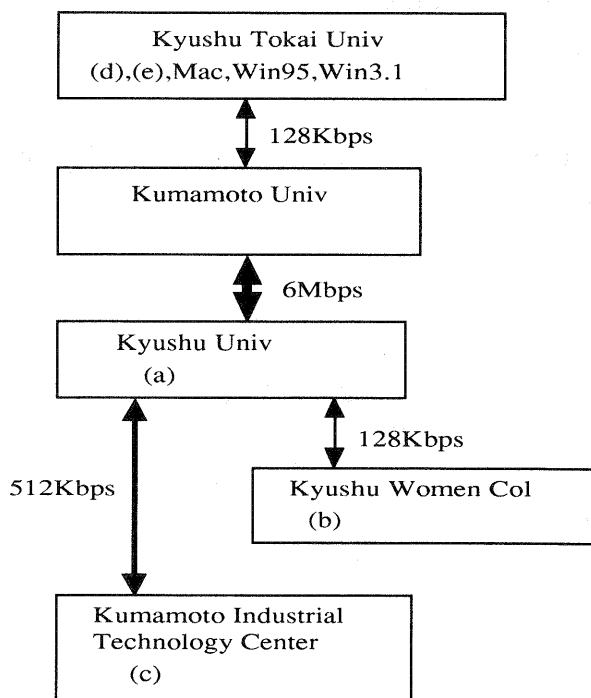


Figure 6 Network configuration for the present measurement 'traceroute' command of UNIX. Figure 6 shows the network configuration for the present measurement of the network load. The large discrepancy between Win3.1 machine and

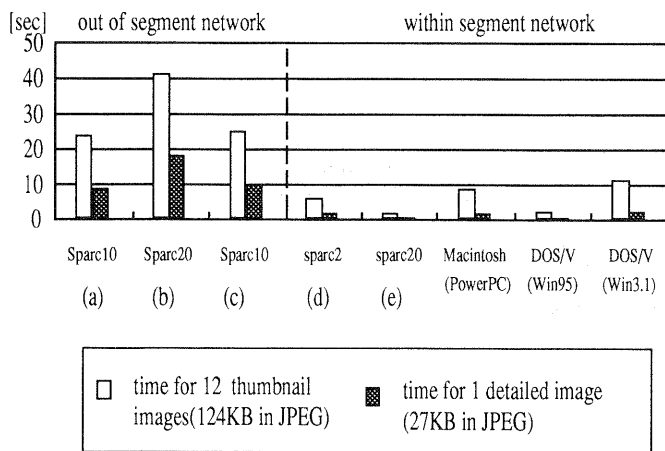


Figure 7 Expanded and displayed time of images on various client machines

Win95 machine is attributed to the large difference of the network performance. Figure 7 shows the comparison of the time for thumbnail images to be expanded and displayed with the time for the selected detailed image on various client machines. The influence of the network load on the total time for images to be displayed on the screen of client machines is very critical as seen in Figure 7. Since the ratio of the retrieving time to the total time for images to be expanded and displayed

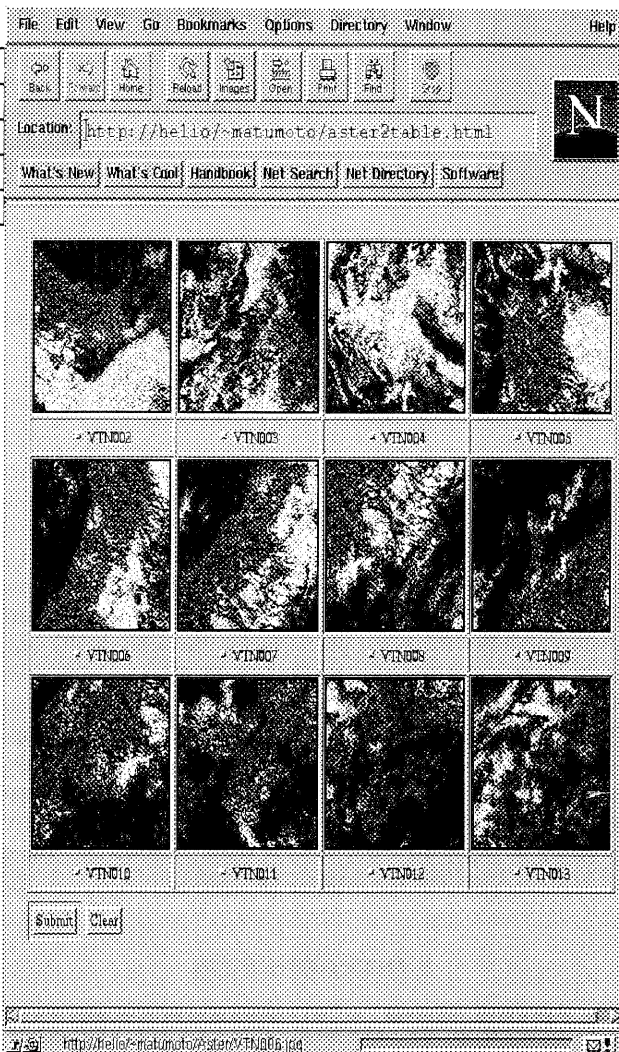


Figure 8 Example of layout of 12 thumbnail images on the window

workstation might be acceptable in practical use. On the other hand, WWW browser on the personal computers seems to be rather poor for expansion and displaying thumbnail images and detailed images. Figure 7 shows the window for end-user to enter retrieval conditions. We have tentatively selected some items such as date, path, row, sensor's name and quality of the image, i.e., the portion of clouds to the whole satellite image. Example of the layout of 12 thumbnail images on X-Window of the workstation is shown in Figure 8.

3. CONCLUSION

Preliminary satellite data retrieval system was constructed on WWW server workstation. It was manifested that the operability for end-user was fairly good because of adopting WWW browser's graphical user interface. Measured real time for thumbnail or detailed images to be transmitted on the network, expanded and displayed on the display holds acceptance in practical use.

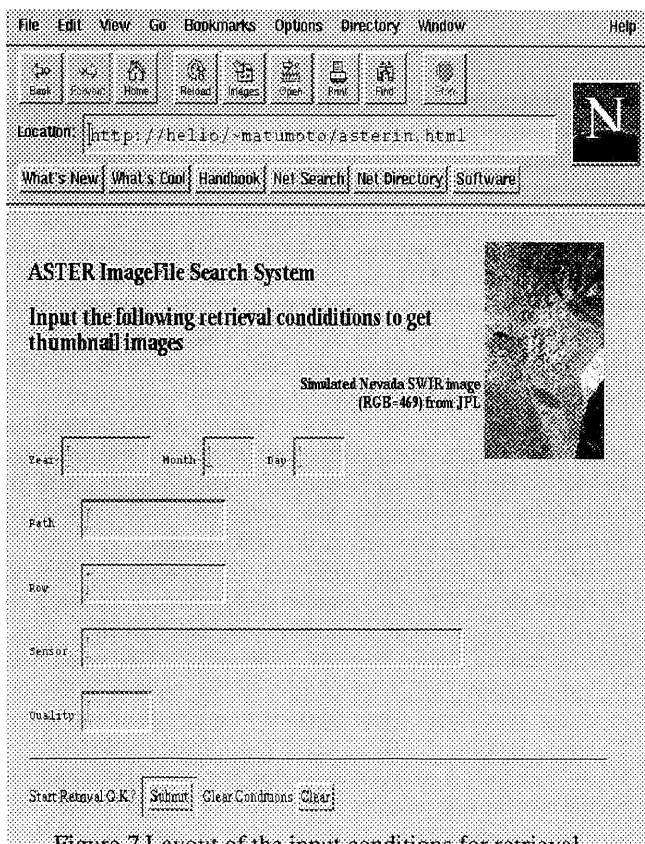


Figure 7 Layout of the input conditions for retrieval

played is considerably small, the measured real time mostly depends on the network load. The total time for 12 thumbnail images to be transmitted and displayed on the display of the