

DIGITAL MAPBASE

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ABSTRACT:

High-resolution satellites such as IRS-1C/1D/Resourcesat-1 and Cartosat-1 have been launched to cater the needs of various application users. These satellites carry panchromatic sensors of 5m or 2.5m resolution respectively. To upsurge the utilization of this data and to improve the image interpretation capability, various digital image processing techniques have been implemented as software utilities. These are being used operationally at value added products generation centers of NRSA. PAN and Multi spectral data merging is used to achieve high-resolution multi spectral data. This type of data increased the demand for toposheet based merged products for national missions (projects), which are of bulk quantity ranging from 500 to 4000 products at various scales. All map based merged products generated so far have been archived and created a database for future reference. These products are used for applications requiring temporal studies. To organize the database for easy access and retrieval, a software package "Digital Mapbase" is developed using java as front-end and MS-Access as backend. The thumbnail images (using customized compression technique) of this database are linked to GUI of the package for faster access. This package provides facility to view the browse images of the database with various input queries like toposheet Id., place name or geographic coordinate etc. The metadata corresponding to each product of the database can also be accessed. This paper enumerates the database information in detail and the techniques adopted at various levels of database retrieval and graphical presentation.

1. INTRODUCTION

National Remote Sensing Agency is the nodal organization in Department of Space, for acquiring, processing and disseminating data of various satellites at different processing levels based on user requirement. It has an archival data from different sensors. Today remote sensing data has become one of the essential tools for natural resources management and development.

Image acquired from satellites will have a location inaccuracy around 1.5km. This creates a major predicament where location accuracy is the vital essence for various remote sensing applications. Most of the users require precision geocoded products from remote sensing data. These products are generated using SOI maps or precision GCPs as reference. It is planned to archive these toposheet based geocoded products them and use as reference for generating future products which can result in reduced turn around time and ease of operations.

The software package is an interface between such archived data and the user.

1.1 Need of the database and Package

Generation of Toposheet based products requires skilled manpower and are time consuming, as data selected will be of multi satellites according to the season constraint from user and data Processing becomes difficult while eliminating radiometry imbalance, mosaic effect and to achieving better location accuracy (better than 50 m.). In the light of the above reasons, it is planned to archive such products for future due to

which accuracy of the subsequently generated products is better and the process will be easy as we can do image to image registration while generation future products. For quick retrieval and display of this database, database management software package is designed and developed.

All the toposheet based products are archived and corresponding metadata is maintained as a database so that whenever there is a repeated request for the same toposheet, it can be used as reference and the scene information can be readily accessed. Till now Toposheet based images of entire Andhra Pradesh, Karnataka, Gujarat, Andaman & Nicobar Islands, Delhi and part of Jammu & Kashmir are stored. Apart from these, some more products were generated covering different parts of Indian region at user requests. Till now 3000 toposheets based geocoded products are archived out of 4000 toposheets of full India coverage. All the images are generated using Polyconic projection with Everest datum.

For accession of the database, a web enabled front-end is developed. Compressed Images of this database are linked to this GUI, so that toposheet based coverage can be viewed as digital data as per the requirement. The disk space requirement for the browse data of image database will be around 4GB for covering entire Indian region along with metadata.

1.2 Design & Development Aspects

The software is developed using 'Java' with Oracle backend to make it platform independent and web based. The disk space requirement for the software with all support files along with database (sub sampled and compressed) is maximum of

4.5GB. Hence it is planned to store the full resolution images in removable RAM media. In case of CDs, each CD accommodates 6 images and total of 750 CDs are required to store total Indian region data of one image for each toposheet. If DVDs are to be used, then requirement reduces to 96 DVDs. As the archival will be ever increasing, it is planned to use DVDs, which not only reduces the physical storage space but also are of better reliability and better data security. The compressed images along with metadata are input for the interface package will provides 3 types of information to the user. The database is designed in 3NF(third normal form) to avoid inconsistencies. As the compression method used is customized, browse images files cannot be used outside the package.

1.3 Database Details

The database is maintained as of 6 tables for storing data corresponding to images, maps, states, districts and places. Fields of each table are given below:

State: StateId, StateName, Color_Id, Capital, No_of_districts, Map grid rows, Map grid columns.

District: StateId, DistId, Dist_Name, Head_Qtrs, No_taluks

Place: Place, DistId, StateId, Lat, Lgt, Place_Level

Map: MapId, Scale, res-status, Coverage, backup, datatype, mask-flag, no-masks.

Image: MapId, ImageId, project, CDNo, Projection, datum, ellipsoid, orgPar, orgMeridian, stdPar1, stdPar2, zone, tlx, tly, resolution, falseE, falseN.

State: MapId, ImageId, SceneId, satellite, sensor, subscene, path, Row, DOP.

The relationship between tables is shown in Figure 1. As the database is basically Toposheet based, most of the tables contain Map id as part of their primary key. And in case of other tables the Map Id is estimated during process. It explains that there can be many districts for each state record and there can be many places for each district. Similarly there can be many scenes for each image record and many images for a map record. The primary archival information is embedded with in the map table, as basic search will be for map Id. As the archival information is also available, first hand information about the status of the map image in the archives is known instantaneously.

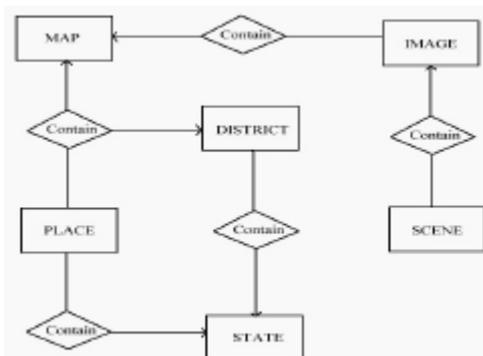


Figure 1: Database ER Diagram

2. SOFTWARE DESCRIPTION

The accession of database is in two modes namely Query Mode and Interactive Graphical mode (Fig-2). In case of Graphical view, user need not provide any inputs. On selection of this option, full India image will be displayed and Geographic information and corresponding toposheet no., will be displayed in the status bar with mouse movement over the Indian region. If the user is well acquainted with his area of interest over Indian region, he can directly click the cursor on the target to display the corresponding image from database (fig-3).

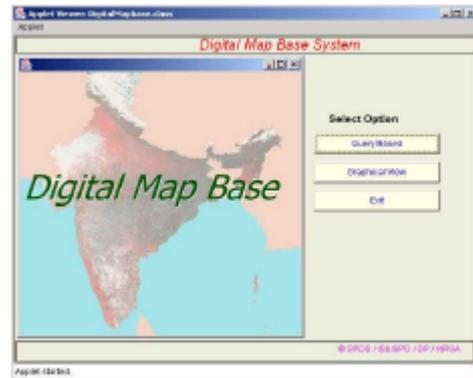


Figure 2: Main menu

In case of query mode the data can also be accessed based on the input queries like Geographic location, Toposheet No. and Place name (fig-4).

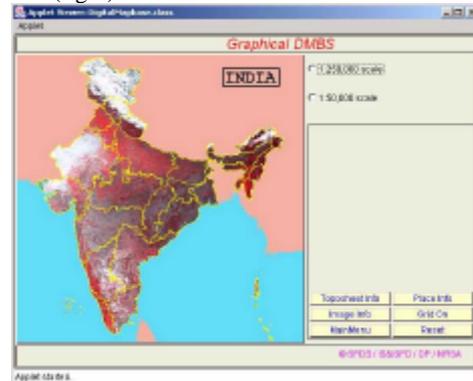


Figure 3: Interactive menu

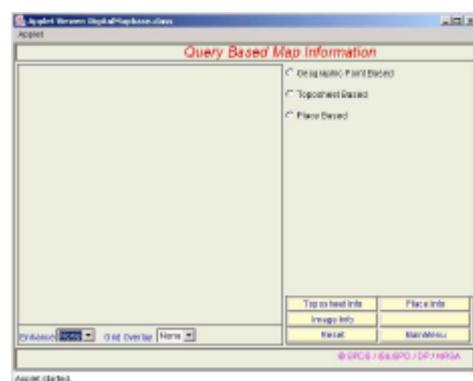


Figure 4: Query based menu

Based on the selection of input type, the input query panel will be changed. In “Geographic coordinate” option (Fig-5) user can enter the coordinates in degrees or in “DD-MM-SS” mode where as in toposheet based option (Fig 6), SOI map index number is to be given as input. Alerts for wrong entries are provided wherever required. Once the valid inputs are given the thumbnail image of the selected toposheet will be retrieved from the database and displayed in the window provided. Online Image enhancement and 15’X 15’ and 5’ X 5’ grid overlay facility are also provided. The Geographic coordinate of the position on the image along with corresponding toposheet is shown in the status bar. The places covered in the selected toposheet image are given in the list box provided. On selection of a place, the position of it in the toposheet will be marked and Place Information can be viewed by using “Place Information” button (Fig-7.). “Toposheet Info” button provides the details of the toposheet like the region covered in the toposheet, whether it is restricted or not, the adjacent toposheet nos., etc (Fig-8.). Reset button can be used to refresh the windows. The “Image Info” button provides the information corresponding to archival details, Scene details like the satellite data used for the image generation and the corresponding dates of acquisition and projection information. (Fig-10, 11,12).



Figure 7: Place Information



Figure 8: Toposheet Information

In Place based option first few characters of the place can be entered in the provided Text Field to move the list box to the required position and make the selection faster because by default software will lists all places available in the database. If same place name is repeated for several parts of the country then the place name is preceded with the district code to distinguish them from one another (Fig-9).

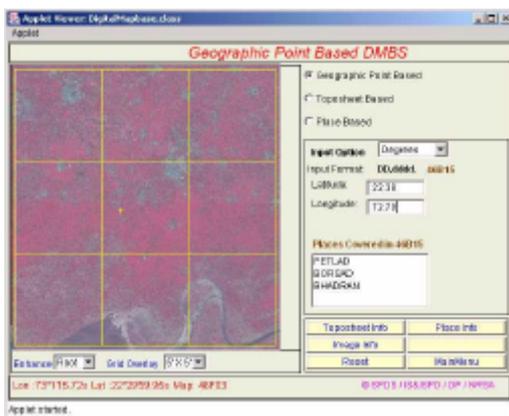


Figure 5: Geographic coordinate based data accession

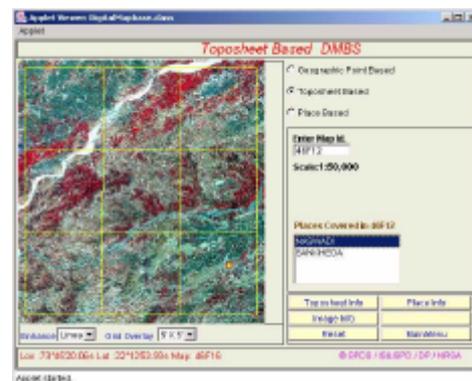


Figure 9: Place based data accession



Figure 6: Toposheet based data accession

The information corresponding to scene details, toposheet details can be seen using the buttons provided. The places covered are shown in the list box and on selection of the particular place it will be marked in the image and details can be viewed using Place Details button. On line help facility is also provided.



Figure 10: General Image Information

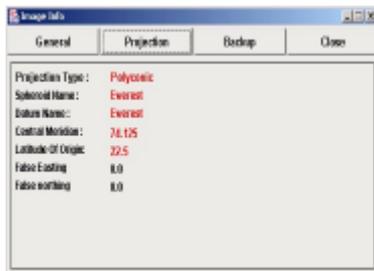


Figure 11: Image Projection Information

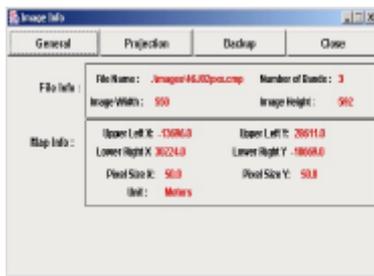


Figure 12: Image Archival Information

3. ALGORITHMS USED

General algorithms for validation of toposheet number, geographic coordinates are used in all the functional modules. These are customized as the threshold changes based on requirement.

“**Inside and Outside test**” algorithm is used for the estimation of places coverage with in the image extent and toposheets coverage with in a given state or district.

Online geographic coordinate information was provided from the cursor coordinates using **spatial transformations** like **affine, bilinear and perspective** based on extent in case of full India.

For better image interpretation image **enhancement techniques** like linear, root and histogram min-max based are used.

Various **projection transformation** algorithms are used for coordinates conversion between map and file coordinate systems. Algorithms for Polyconic, **UTM** and **LCC** projections and datums like **Everest** and **WGS84** are implemented.

A **customized compression technique** is developed using DCT, which includes minimum metadata corresponding to image on hand for better data security. The main feature of it is optimised quantification table generation. Though the compression ratio achieved is less compared to established compression techniques, it is almost loss less hence the quality of the browse images will be better maintained.

4. APPLICATIONS

This package along with database and archival is being used as reference data in NRSA for regular value added products generation and is being updated with new datasets whenever possible. It improved turn around time of data processing chain and provided consistent accuracy for the products. This is

also being used for visual verification of data received for completeness, before initiating the product generation and also as reference during internal quality control at special products generation centres for correctness of the end products before sending to Quality control and data dissemination.

CONCLUSION

Once Indian region is covered, this package with browse image database can be ported on to NRSA website for internal and external users access. It provides most of the essential information like coordinate extent, area coverage, places covered and sensitive areas coverage required by the users. This package can be further extended by providing online AOI selection facility (in interactive mode) and including state and district mosaic viewers. Whenever images are generated with new or better resolution data, browse images of the same can be appended or updated as new images. At present more than one image in database is also planned and initiated. The scene details provided are based on referencing scheme of the satellite, which will be correct under ideal conditions of orbital elements. However there may be minor variations due to day to day changes in orbital position of the satellite.

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