Satellite Image Repository System and Web Enabled Search Engine

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Abstract— This paper articulates the design of a Web application that can integrate geospatial data management, visualization with capabilities of semantic search and web-mining technologies. This provides for the seamless integration of data sources from different satellite sensors through the single interface. The paper presents implementation of a Satellite Image repository with the aim to optimize the manual Search and download system. The objective is to design an automated system (computerized) which should undertake all the jobs that are essential for all the pre-requisites, searches and download of information about the imagery data. The system is capable of processing the various queries and searches placed by the users and respond in least time with most comprehensive and descriptive data.

Keywords—, Remote Sensing Satellite data, Repository, Web enabled services)

I. INTRODUCTION

Indian Space program has increased manifolds with the launch of a new series of satellites and sensors each year. The first operational Indian remote sensing satellite went up in space on March 17,1988 . With the launch of each remote sensing satellite , the data is increasing exponentially both in content and usage. Today each remote sensing user organization has multiple terabytes of remote sensing data in forms of images acquired by them since the inception and launch of remote sensing satellite . Some of this data is of historical nature as the satellite which recorded this data has already lived its whole life and no further recording is being done by the particular satellite .

With such vast amount of satellite data, the questions arise on how to process , manage , archive and make best use of this remote sensing information which can benefit the users at large. Indian Institute of Remote Sensing , is a premier training and education institute setup for training professionals in the field of Remote Sensing, Geoinformatics and GPS Technology for Natural Resources, Environmental and Disaster Management. A large amount of remote sensing satellite data for Indian Remote Sensing(IRS) satellite Series is available at the institute . A need was felt to organize all the satellite data at a central repository with an automated metadata extraction which will serve as electronic library of all the satellite data that is available at the institute. Once a central repository is built , fast and efficient retrieval of data from this electronic library is possible.

With this aim it was decided to build a prototype to achieve the above objectives . It was decided that an automatic metadata extraction software package will be developed that takes input from the header of the image and automatically stores the relevant information into a database . It was also planned that once the metadata extractor is developed all the data will be ingested into the database. The resulting database would be further used for developing an Intranet based web enabled search engine in which querying the database on various fields is possible.

II. CONCEPTUAL MODEL

The Remote Sensing database is different from traditional databases. With rapid advancement in the field of Remote Sensing , a huge amount of Remote Sensing database and knowledge base can be made available instantaneous to varied kinds of uses simultaneously. Hence development of Remote Sensing image information management system must be able to handle a vast volume of data based on the requirements of the institute.

It was decided to develop the central data repository in two stages. The first stage involved data ingestion, metadata extraction and generation of Browse Image which will build the digital database. The second stage would be to utilize this digital database and a search engine based on querying different fields of database will be provided to users on an Intranet platform. Figure 1 illustrates the conceptual design of the central satellite image data repository. The module for Metadata extraction was developed in Visual Basic due to ease with which the graphical methods and events can be handled. The Visual part is used to create the graphical user interface (GUI). Rather than writing numerous lines of code to describe the appearance and location of interface elements, pre-built objects are added into place on screen. Visual Basic has evolved from the original BASIC language and contains several hundred statements, functions, and keywords, many of which relate directly to the Windows GUI. Beginners can create useful applications by learning just a few of the

keywords, yet the power of the language allows professionals to accomplish anything that can be accomplished using any other Windows programming language. Data access features allow you to create databases, front-end applications, and scalable server-side components for most popular database formats.

III. DATABASE DESIGN

A database is a collection of objects that allow you to store data, organize it and retrieve. It is a collection of interrelated data stored together with as little redundancy as possible to serve one or more users in an optimal way. A database Management System is a set of computer programs that controls the creation, maintenance and use of a database. It was decided to use a relational data model which contains multiple tables some of which may be related to each other.

The main table of the database was designed based on the metadata information available in the header of the data. The database was normalized. The rules of normalization that were applied are that every table must have a primary key , the primary key can never contain an empty or Null value and every attribute of every occurrence in the table can contain only one value. The database structure is presented in table 1.

In the next stages front end forms were designed which would be subsequently used in program to extract metadata information. The metadata is available in the header file that comes along with imagery data. The software package to extract metadata from header was written, this metadata was displayed and was finally ingested into the database. The snapshots of the metadata extraction software are presented through figures 2 and 3. The browse image was generated for each data.

IV. SEARCH ENGINE

The efficient utilization of the above central repository is possible if it is supported by a strong search engine. Since the computer systems are connected by local area network, the efficient utilization strategy would be to provide the search engine on an intranet platform which is easily accessible via a browser. Aim of developing a search engine is optimize the manual search and download system which is being used in the institution for its various research and training activities. The proposed system will provide the end user, flexibility and user-friendliness with the help of Data entry forms, queries and reports logs. Data entry forms provide an interface to the end user to tackle with the database. It minimizes the chances of error. Queries (search in this case) provide fast retrieval of data from the database. They are provided as per the user specifications. Since the query should serve all personnel – faculty and trainees hence it was decided not to keep security log in.

Queries are said to be a user request for the retrieval of data. In this system user can retrieve data on the basis of a specific Sensor, Latitude and Longitude bounding box, Path/Row Search, search during specific dates and search based on place name. The Query shell was developed using Active Server page (ASP) technology. ASP is a technology to make dynamic and interactive web pages and uses server side

scripting. The default scripting language for ASP is Visual Basic (VB) Script. The VB script is scaled down version of visual basic in which tools are added for interaction with web pages. Any webpage containing ASP cannot be run by opening it in a web browser. The page has to be requested through a server that supports ASP. Appearance of ASP page is like any normal HTML webpage. The query shell is available on the institute intranet site http:\\iirs-5\menu.asp. The query front end is illustrated through figures 4- 8 and the sample output in figure 9.

V. CONCLUSION

The database management technology is quite popular since last few decades for storing related data in an efficient and compact manner. Specialized databases have existed for scientific, imaging, document storage and like uses. Remote Sensing technology is providing vast amount of data of earth surface . Integration of Remote Sensing and modern database technology can make possible the management of huge amount of Remote Sensing image data. It not only significantly increases the system efficiencies, scalability, security and integrity it also extends the application of space of the satellite image. The developed system is user friendly system, i.e any user can handle the system by mouse click, user need not be expertise in database management system programming. Even a layman can handle this system. To acquire the information about various fields in the database system, user need not have to run any other available software and face problems due to lack of expertise

TABLE I.   DATABASE STRUCTURE FOR CENTRAL SATELLITE IMAGE DATA REPOSITORY

Database Field	Type and Size	Description
slno	Autonumber	A number which automatically increments and is unique. Hence can serve as primary key for the database
satellite	Text , 50	Holds the name of satellite which captured the data
sensor	Text , 50	Name of sensors onboard the satellite
specmode	Text , 50	Hold the information about panchromatic / Multispectral mode
path	Integer	Stores the Path number
row	Integer	Stores the Row number
dateACQ	Date / Time	Field used for the date and time of acquisitioning the imagery
scentrelat	Integer	Field for the scene centre latitude coordinate
scentrelong	Integer	Field for scene centre longitude coordinate
scentreline	Integer	Field for the scene centre line number
scentrepixel	Integer	Field for the scene centre pixel or column number
topleftlat	Integer	Field for the Top Left latitude coordinate
topleftlong	Integer	Field for the Top Left longitude coordinate
topleftline	Integer	Field for the Top Left line number
topleftpixel	Integer	Field for the Top Left centre pixel or column number
brightlat	Integer	Field for the Bottom Right latitude coordinate
brightlong	Integer	Field for the Bottom Right longitude

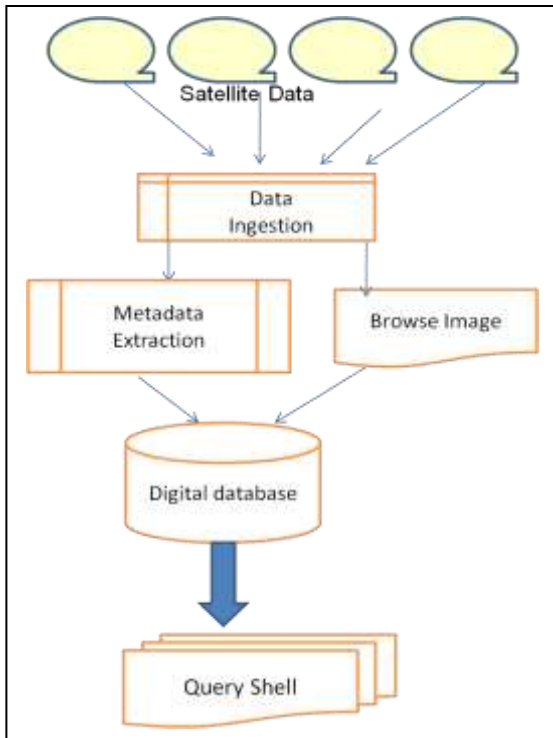|		coordinate
brightline	Integer	Field for the Bottom Right line number
brightpixel	Integer	Field for the Bottom Right pixel or column number
pixperscan	Integer	Field for Number of Pixels per scanline
noofscan	Integer	Field for Number of Scanlines

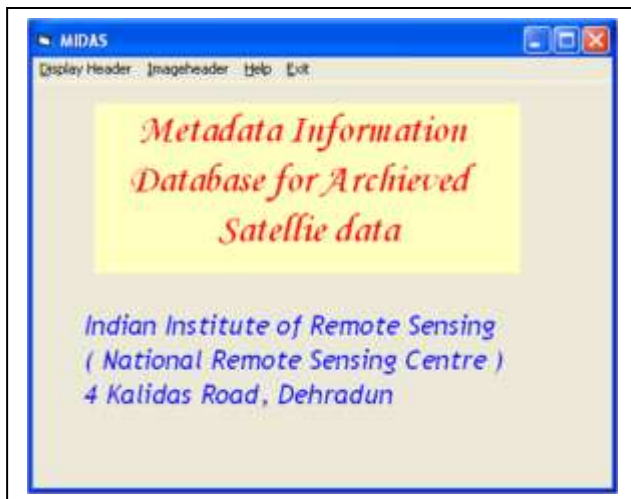Figure 1. *The conceptual model of the Central Repository*
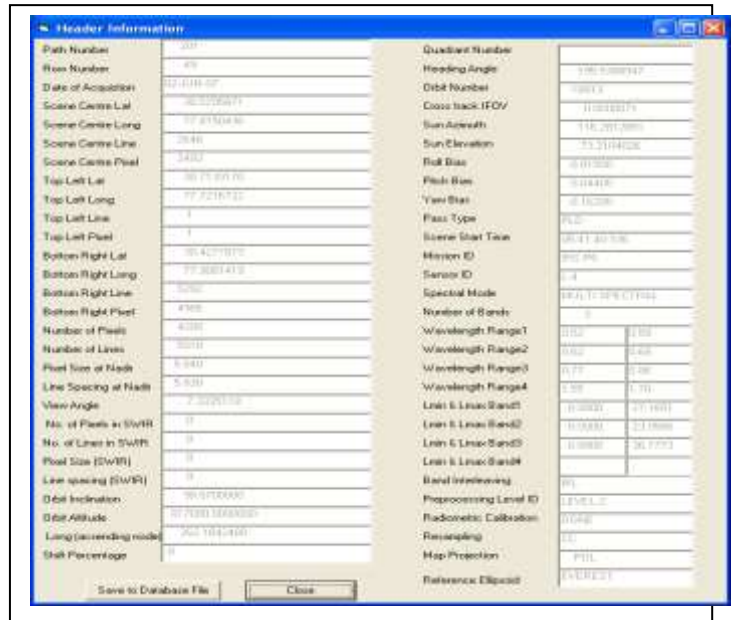

Figure 2. *The metadata extraction front end*

Figure 3. *Metadata information extracted from header*
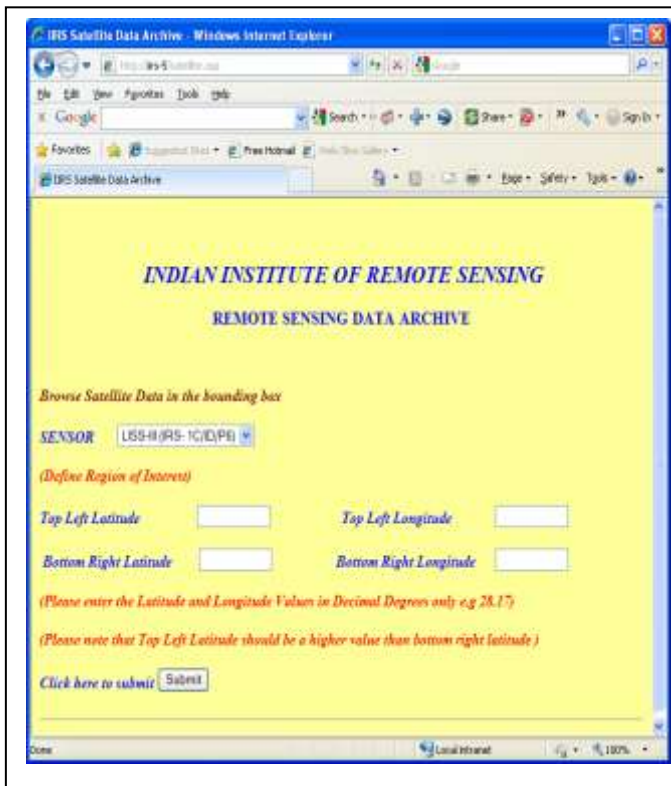

Figure 4. *Query Shell Front End*

Figure 5. *Sample Query Based on Bounding Box*
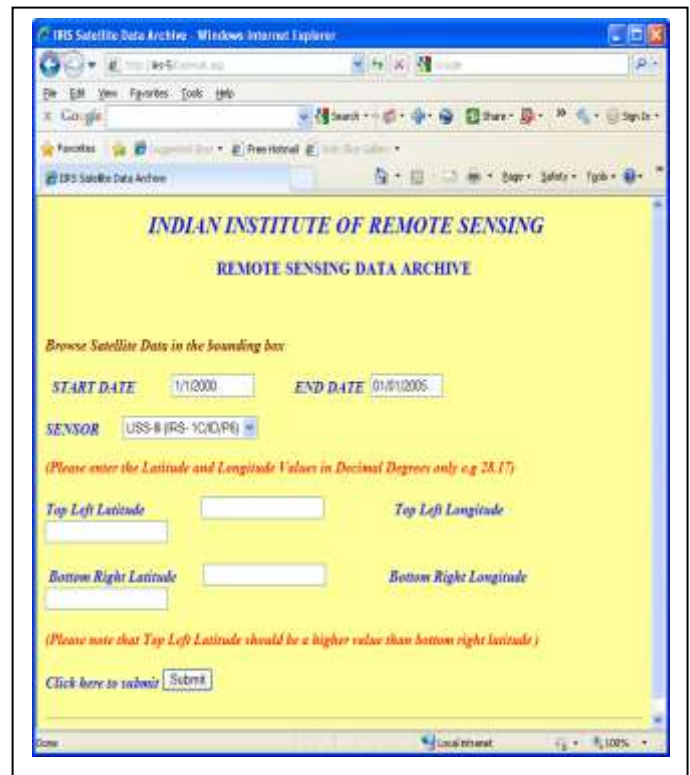

Figure 7. *Query Basedon time period for a specific sensor*

Figure 6. *Query Based on Path , Row and Sensor*

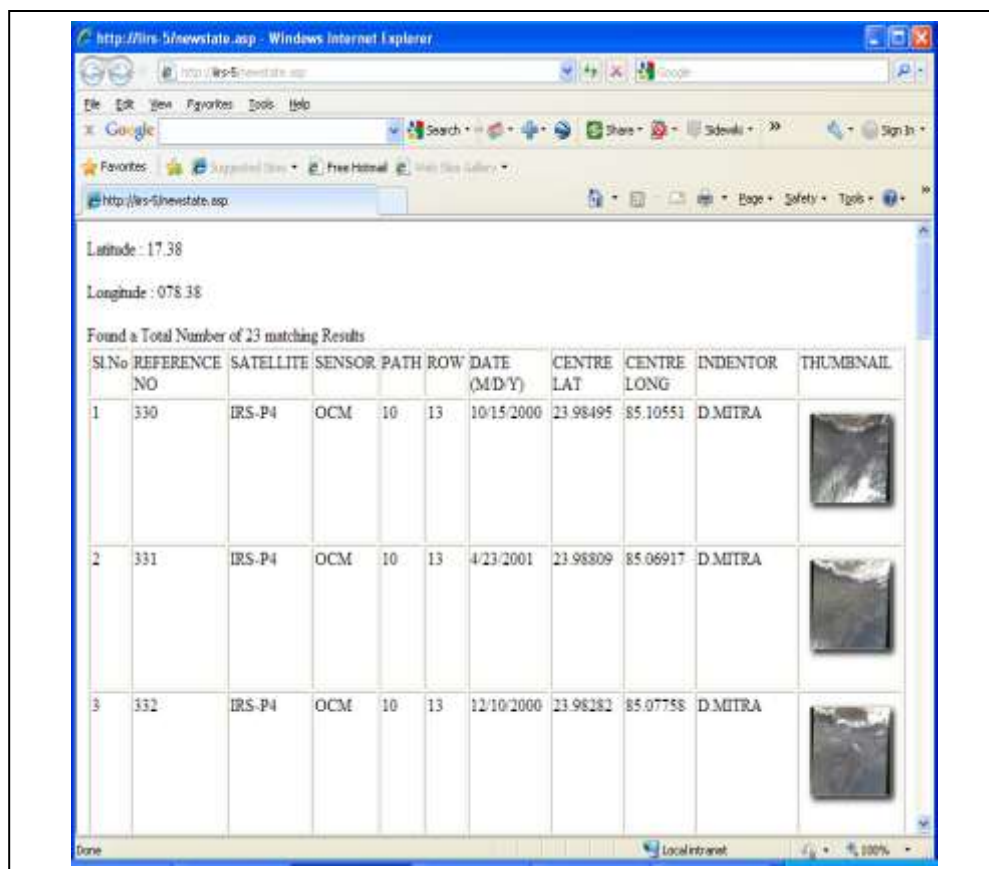Figure 8. *Query Based on State and Place Name*

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Figure 9. *Sample Query Output*

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