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|  | | **Hope Foundation’s,**  **Finolex Academy of Management and Technology, Ratnagiri** | | | | | | | | | |
| **Department of Information Technology** | | | | | | | | | |
| Subject name: OLAP LAB | | | | | | | | Subject Code: ITL503 | | | |
| Class | | TE IT | | Semester – V (CBCGS) | | | | Academic year: 2018-19 | | | |
| Name of Student | | **Kazi Jawwad A Rahim** | | | | | **QUIZ Score :** | | | | |
| Roll No | | **32** | | | Experiment No. | | | | | 06 | |
| Title**: Case study: Spatial database design and management** | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 1. **Course objectives applicable:**   **LOB3**- To get familiar with the emerging data models | | | | | | | | | | | |
| 1. **Course outcomes applicable:**   **LO3**- Understand the basic concepts of spatial databases and its design. | | | | | | | | | | | |
| 1. **Learning Objectives:**  * To be familiar with design considerations of spatial database. * To understand applications and features of spatial database. * Learn about the components of SDBMS. | | | | | | | | | | | |
| 1. **Practical applications of the assignment/experiment:**  * Business/ Enterprise application: GIS applications which stores and capture geographical and location data. E.g. google Maps. | | | | | | | | | | | |
| **5. Prerequisites**: Knowledge of Databases, GIS, spatial data. | | | | | | | | | | | |
| **6. Hardware Requirements**:   1. PC with 4GB RAM, 500GB HDD,   **7. Software Requirements:**   1. Windows 2. web browsers (Chrome, Firefox) 3. Word Installed | | | | | | | | | | | |
|  | | | | | | | | | | | |
| **8. Quiz Questions (if any): (Online Exam will be taken separately batch wise, attach the certificate/ Marks obtained).**  **1. What are the features of spatial databases?**  **2. What is spatial Data?**  **3. How to represent spatial data?**  **4. How to process the queries?** | | | | | | | | | | | |
|  | | | | | | | | | | | |
| **9. Experiment/Assignment Evaluation:** | | | | | | | | | | | |
| **Sr. No.** | **Parameters** | | | | | | | | **Marks obtained** | | **Out of** |
| **1** | Technical Understanding (Assessment may be done based on Q & A **or** any other relevant method.) Teacher should mention the other method used - | | | | | | | |  | | 6 |
| **2** | Neatness/presentation | | | | | | | |  | | 2 |
| **3** | Punctuality | | | | | | | |  | | 2 |
| **Date of performance (DOP)** | | |  | | | **Total marks obtained** | | |  | | **10** |

**Spatial Database**

**Delhi State Spatial Data Infrastructure**

**(DSSDI)**

**Department of Information Technology, Government of NCT of Delhi**



1. **SUMMARY**

The Government of Delhi initiated the Delhi State Spatial Data Infrastructure project in 2008 with the intent to use the geospatial technologies in governance / urban planning.

DSSDI project was an outcome of a pilot project by Department of Science and Technology, Government of India, on 3D GIS in Chandani Chowk area, Delhi. The project has proven to be of immense usefulness, especially the 3D databases, for various applications for Government of Delhi. It has enabled change detection on real time as occurring on the ground. The project covers a total area of NCT Delhi of approximate 1500 Sq. km. The Project was proposed to cover all lands, buildings and all underground utilities within the NCTD. The project was proposed to facilitate detection of illegal constructions by the Government of Delhi and monitoring of any changes being made in respect of land and building in NCTD on real time basis.

The project has proved to be the forerunner of many such SDI (Spatial Data Infrastructure) projects within the country, which will give a very sound foundation for e-Governance.

**2. INTRODUCTION**

The scene of an urban landscape is generally similar across Indian cities, including the metros, and Delhi is no exception. There is the 'old city' area, Chandni Chowk, which has somehow withstood the onslaught of the construction boom, preserving its narrow lanes and cluttered dwellings and shops. Here, the roads get dug up frequently to make room for more sewage lines, telephone ducts, gas pipelines and electric lines. Once you travel away from this 'heart' of the city, you may find yourself in a relatively planned neighborhood. Here, one will find new construction activities in full bloom, along with road widening and laying of new underground utility lines. It is a chaotic backdrop in front of which the Government of NCT of Delhi works hard . The government required a vision to make this a less chaotic scene. They wanted a tool, a system, which could pinpoint location of a cable duct underneath a busy road, or the correct location of a disputed land holding. to provide all utility and related services to its citizens and at the same time tries hard to keep in check illegal construction and its associated menaces.

**3. PROJECT OVERVIEW**

Earlier, there were deficiencies in scientific urban planning and lack of basic authentic physical spatial data. Geospatial data was either not available or it was available in fragments with some individual departments. Repeated field surveys were required whenever any department needed geographical attribute. No standard mapping procedures were followed. Thus, integration of maps was not possible and strategic planning based on holistic geospatial data & attributes was not possible. There was no reliability of data either. Different results would be given when data was sought at different times. Searching, collating and analyzing data was a herculean task in itself involving lot of time and effort. Top level management was unable to get an overall view of the ground level attributes / status along-with geo-spatial data.

Seeing the impending requirement of a system which could provide holistic and uniform ground level realities to the top level management, an MoU was signed between Delhi Government and Survey of India in 2008 to implement the DSSDI project. Contract was awarded on March 7, 2008, through competitive bidding.

Entire area of Delhi (except the restricted area) has been covered under the project. The dataset of the DSSDI project includes 356 geo-spatial layers (above the ground, on the ground and below the ground) with the attribute data of about 29 departments / agencies.

The project was intended to achieve high accuracy GPS surveys for entire Delhi, establishing control network including monuments, photogrammetric capture (from aerial photographs and in 3D) of roads, buildings, parks, water bodies and all over-ground features, generation of base map on 1:2000 scale and an Orthophoto; surveys for underground utilities using Ground Probing Radars; creation of Land Information System (LIS) and Urban Spatial Information System (USIS), setting-up of 2 Control Centers and 10 Monitoring Centers with IP Cameras and a DSSDI Portal for line departments of Government of Delhi, and generation of 3D pictorial data base as well as capacity building for line departments of GNCTD. The LIS was conceived for up to date cadastral information. The USIS was conceived for the spatial data/information requirements of urban planning for routine functions of the line departments of Delhi.

GNCTD, through legislation has made it compulsory for all government departments to use the common database created under DSSDI project. All GNCTD departments are duty bound to update the data periodically. It is mandatory for all line departments of GNCTD including civic authorities, planning bodies, custodian of cadastral maps and other users of public money to use common digital database with multiple layers as a means of reducing conflicts while undertaking future planning, design engineering and construction activities including digging the roads. DSSDI data is also being used for:-

a) City planning

b) Urban development

c) Land management

d) Management of over ground / underground utilities

e) Traffic management

f) Property tax/other revenue collection,

g) Updating property records,

h) Pollution and environment monitoring,

i) Security planning and management,

j) Hazards and Disaster Management,

k) Change detection Analysis of building construction

l) Deciding the Title of Land/building by judiciary.

**4 . MODALITIES OF THE NEW SYSTEM (SOLUTION)**

* **Details of the solution(s) that is implemented:**

1) Before the Delhi Geo Portal could go live, it obviously required the databases, maps and the related logic to be built into the system. The preparatory activities included high accuracy GPS surveys for entire Delhi, establishing control network including monumentation, photogrammetric capture (from aerial photographs and in 3D) of roads, buildings, parks, water bodies and all ground features, generation of base map on 1:2000 scale and an Orthophoto; surveys for underground utilities using Ground Probing Radars. The above activities led to the creation of Land Information System (LIS) and Urban Spatial Information System (USIS), setting-up of 2 Control Centers and 10 Monitoring Centers with IP Cameras and a DSSDI Portal for line departments of Government of Delhi and generation of 3D pictorial data base as well as capacity building for line departments of GNCTD.

2) The LIS was conceived for up-to-date cadastral information. The USIS was conceived for the spatial data/information requirements of urban planning for routine functions of the line departments of Delhi.

In order to effectively utilize the geospatial data for urban planning, “The Delhi Geospatial Data Infrastructure (Management, Control, Administration, Security and Safety) Act, 2011” was notified.

3) It envisages inter-alia:

* Mandatory sharing, accessing and utilization of Delhi Geo-Spatial Data (29 line departments were identified)
* Setting up of Legal entity under section 25 of the Indian Companies Act (namely Geospatial Delhi Ltd)
* Service level agreement with other departments
* Establishing Regulatory Authority for enforcing provisions of the Act

**5 . Innovativeness of the project:**

* 63 IP cameras located at building tops with the capability of detecting changes up to a distance of 3-5 kms. The wireless remote controlled cameras monitor the entire Delhi for unauthorized constructions and also used by the Police for surveillance and management of security events. 2 Control Centers and 10 Monitoring Centers connected through IP cameras at strategic locations.
* The online video recording with change detection facilities is able to pin point unauthorized constructions as well as act as ears and eyes of Government during major events and demanding situations involving serious accidents/disasters.
* Government departments are able to add data of public interest such as online availability of beds in the hospital, availability of vacant seats in the educational institutions and update them from time to time.
* Keeping the security aspects in view, select layers of DSSDI are also available in public domain to users across the nation via internet thus commencing the digital era. All other layers are available to authorized users of line departments of GNCTD. Geospatial Delhi Limited, a company already incorporated and functional owns and manages the process.
* **Technology Platform used:**

The Delhi GeoPortal solution is centered as a Service Oriented Architecture (SOA). It is independent of data format and is platform-neutral. This enables exchange of information with any other service within the reach of the network without the need to make changes to the underlying program itself. The end user is able to avail GIS functionalities using standard web browser. The web portal is linked to around 28 stakeholder departments currently. Dedicated 4 MPLS network is being used as virtual private network. The network is configured with a unified architecture and provides scope for future scalability of the whole system without major architectural changes.

The Delhi GeoPortal -

* provides a solid foundation to discover, query, and access multi- geospatial data and services
* enables Portal users to connect with related user departments through authored channels, search for and view metadata, access and view geographic data and Web services, and publish (register) their metadata and services on the geo-portal and facilitates value added applications from the main server
* Moreover, mobile GIS enabled person are based in the field to acquire, store, update, analyze and display geospatial information. Mobile GIS integrates one or more of the following technologies:

1. Mobile devices.
2. Global Position System
3. Wireless communications for Internet GIS access

**6 . Security/ User Management and Administration**

Security is one of the important components in the entire system. Access to the system is password protected. DSSDI Project has implemented various layers of security.

* Physical Security
* Software Security
* User Management and Administration: For secured and authorized access to Data, Network, Devices and Application
* Physical Controls: Physical controls to access the data center and other resources
* Access Control (Web Feature Services) : Secure access to data
* Service Continuity: Redundant IT resources, including bandwidth
* SSL : The DSSDI portal has been developed and deployed on Secure Intranet. The DSSDI Public Portal has been developed using SSL.

**7 . Any issue with the technology used:**

* Initially there was a delay in GPS observations because of unprecedented rains. Difficulties were faced in survey of properties because of unavailability of residents or resistance on part of residents to provide data
* In some cases, there was a delay in providing attribute data by stakeholder departments due to exigencies, elections, manpower constraints etc.
* While connecting IP cameras to monitoring centers, it was observed that some of the buildings had excessive interference due to other radio waves. This implied that wireless feed was not of high quality and leased lines had to be considered

**8 . Service level Agreements (SLAs):**

* The MOU between GNCTD and SOI (Survey of India) was signed with Government of Delhi.
* There were various SLAs that were signed with MTNL for providing connectivity to the departments.
* Multiple department level SLAs will be in picture once the citizen centric information will be provided by GSDL.

**9 . Measures to ensure replicability:**

* The DSSDI Project has a highly distributed, replicable and scalable architecture. The project has implemented 10 identical Monitoring Centers equipped with miniature version of the Control Centers to share the load when required. The Monitoring Centers also balance the load of Change Detection Processing for all IP Cameras deployed across the city. In case of failure of a Monitoring Centre, the entire processing can be shifted to another Monitoring Centre on the MPLS.
* The system has been implemented on state of the art Enterprise Grade Equipment. The current storage requirement of the project is 25 TB and the available storage subsystems are scalable up to 96 TB. The Database server is currently populated with Dual EPIC Processors and is scalable up to eight processors providing a 4 times scalability in processing performance when required.
* Currently, 28 stakeholder departments have leased line facility

**10. Restrictions, if any, in replication and or scalability:**

DSSDI Project has a highly distributed, replicable and scalable architecture. Hence there are hardly any restrictions for its replication or scaling up in future as required. Redundancy is maintained by having 10 monitoring centers and in case of failure in one or more centers, remaining centers can cater to the additional load.

***Risk Analysis:***

The project involves gathering, processing, analysis and publication of geo spatial data which may capture details of sensitive establishments, such as layouts, bird's eye view showing detailed facility structure as well as personally identifiable data such as housing scheme layouts and locations of specific assets. Moreover, during processing of data, the data may get modified intentionally or unintentionally, if it fell in wrong hands. Thus, data security was a critical risk that was analyzed early and addressed by hosting the data at the secured data center and using secured and encrypted connections. Data open to public access was only for viewing purpose, without any scope for modification.

**11. Impact on the Stackholders/Beneficiaries**

* **Cost benefit analysis:**

Each of the department especially like MCD are likely to increase their revenue by 50 % immediately and other departments cost will reduced by on average of 20 to 30%. Costs are further reduced as the leased line access available to departments enables visualization of database on computers, thereby reducing the need for excessive printing through costly plotters.

* **Value delivered (qualitative and quantitative):**

*****To Organization:***

* All stakeholder departments have access to Geospatial maps/imagery along with attribute data in respect of more than 356 layers (as authorized) through a dedicated high band-width (4Mbps) leased line. The graphic interface provides easy navigability after clicking on the website icon. Use of DSSDI database will lead to enhancement of property tax collection, report generation on status of property tax and updates on tax paid.
* The DSSDI project has revolutionized the planning process. Generation of high resolution maps (on a scale of 1:2000) with attributes, have facilitated micro level planning. There is reliability of results. Query facilities have drastically reduced the time required to access data, analyses it and present in a form that is useful. Now there is no need for each department to do field surveys as the DSSDI database/maps are available. This has led to savings in costs of repeat surveys.
* The top level management is now able to get overall view of the ground level attributes/status along-with geo-spatial data, thereby facilitating planning for remedial measures.
* The “Plan Dig Monitor Application” has eased the process for the departments for planning and getting utility and spatial information of the area of interest, for digging/excavation purposes.

***To Citizens:***

Applications for using mobile and GIS are being conceptualized. For example, a mHealth system can serve pregnant women. The pregnant woman can send SMS via GPRS network thereby giving her ID and coordinates (Longitude and Latitude). The server, on receiving the SMS can search database and help the pregnant women in different ways e.g. find her location (home, market, etc.) in emergency cases, inform ambulance service about the co-ordinates, advise about the nearby health care centers, send message to nearby hospital etc.

***Other Stakeholders:***

Through the PDM Application, online enrolment of contractors and grant of permission on a single window interface would be possible in a few months.

**12. Future roadmap**

The existing portal is being revamped for streamlining web enabled single window services to contractors for registration and permission for construction/excavation activity. It is proposed to set up a separate Geo portal for the public/citizens in the next phase. Crowd-sourcing is contemplated for Geo-tagging, updating and validation of Geospatial/attribute data.

A separate project “Development of Smart city using DSSDI dataset” with an estimated cost of Rs.21.1 crores has been recently approved by the Department of Electronics and Information Technology (DeitY), Government of India under World Bank funded scheme. Citizen centric services will be one of the components of the project.

In future digital certificate tokens are envisaged upon integration with G2C services such as Property Tax etc.

**13.Sustainability**

Since the architecture is such that it has been developed using Open Geospatial Consortium (OGC) GIS standards, there is no vendor lock-in, thereby ensuring longevity and adaptability. A common standard for all departments enables sharing, overlay of different thematic layers, integration of Geospatial data/maps and effective planning on a sustainable basis. The network is configured with a unified architecture and provides scope for future scalability of the whole system without major architectural changes.

Creation of infrastructure and facilities for updating through leased lines between departments and control centers has provided a sustainable basis for updating of data. Frequent updating of data is being ensured by GSDL through field surveys/departmental inputs. Satellite has been purchased in 2012 and has become base for geospatial data updation.

GSDL has large pool of dedicated resources not only for updating the spatial data but also to train the officials of stakeholder departments such as Geospatial Advisors for interaction with the line department and planning of long term and short term activities with the department using Geospatial technologies, Geospatial Executives for development of application software, maintenance of geo-portal, liaison with departments and lastly, Geospatial Associates and Assistants for lab based creation and updation of GIS data using satellite image and departmental inputs. This ensures quality inputs on sustainable basis for data updates, maintenance and utilization.

**References:**

### 1) Object-oriented data modelling for spatial databases

MF Worboys, HM Hearnshaw… - International journal of …, 1990 - Taylor & Francis

**2)** https://link.springer.com/chapter/10.1007/3-540-60159-7\_6