GEODAC Technology Framework

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Executive Summary

In order to benefit society in its struggle to fight disease, improve municipal regional and national public services, enhance disaster warning systems, develop responsive emergency services, GEODAC specializes in providing niche tailored solutions to industries, businesses, civil services, government (local, regional, national) and the military, utility companies, communications companies, and all services where extreme geospatial accuracy and timeliness of information are crucial and essential.

The Problem and the Need

Utilities, civil works construction, government, risk management services, and real-estates require accurate, up-to-date, and easy-to-access "maps" that shows street centerlines, parcel boundaries with full parcel attributes, and elevation data as the base components from which key decisions are reliably made. Typically, the street centerlines are provided by a street map vendor like Tele Atlas, the parcel image maps with attributes are provided by the respective county or from a vendor like First American RES, and the elevation data are provided by organizations like USGS. For a typical project, over 50% of the time spent is drawn from searching, gathering, and assimilating information. This is a tremendous expenditure in overhead that negatively impact productivity and competitiveness. This is a crucial need to be resolved in combining these basic components into a single, cohesive environment that provides accurate and seamless mapping canvas on a nationwide scale and eventually expanded globally.

Currently, such maps and data attributes are maintained by a wide array of organizations in various non-contiguous, disparate forms. Maps are often inaccurate, incomplete and out of date, limited value, and in difficult-to-use formats. In today's competing vendors such as Tele Atlas, Navigation Technologies, Barclay MapWorks, etc., maintaining, accessing, and using maps are time consuming and costly activities done mostly by hand with mid-20th century procedures and technology. There is a significant unsatisfied need for technology and business structure to solve these problems.

The tools and knowledge to address geospatial issues have only come into existence in the last couple of years. However, the entities that need these solutions do not have the economies of scale to pay for them, nor are they able to attract the technical talent to maintain them. In addition, the data conversion effort is labor and expertise intensive and is therefore very expensive. This is where the importance of GEODAC's innovative core technology, GEODAC Technology Framework (GTF), comes into play. This constitutes the flagship core business of GEODAC, herein referred to as GTF.

GEODAC Technology Framework (GTF) Solution

The idea of GTF had its beginning since 1997. It has been gradually developed, refined, and carefully architected GEODAC has undertaken the challenge to fulfill the scope and expectation of GTF which has never been done before. The vast opportunities GTF will bring to the users are believed unprecedented where existing markets will be greatly enhanced as well as new markets expected to be created. The number of well trained staff who has worked together for many years have already established the necessary procedures, internal quality control, and key business alliances to ensure the completion and deployment of the next generation mapping applications.

Combining the broad importance of geography and the power of technology, GTF brings forward a new vision, a new concept, and a practical solution in doing business now and in the future. With GTF suite of possible applications, information is managed in ways it has never been done before and to utilize information in ways it may not have been thought possible. Users at virtually any level of technical premise will have equal access to this new forum of information; it will be easy to use, very practical, profoundly amazing and affordable.

At a high level GTF is an enterprise-wide geospatial technology (GeoBrowser) designed primarily for professionals. GeoMarQ developed by GEODAC is a seamless, parcel basemap. GeoMarQ can be applied as the core layer in GTF that serves as:

- A multi-layered, precision basemap and a
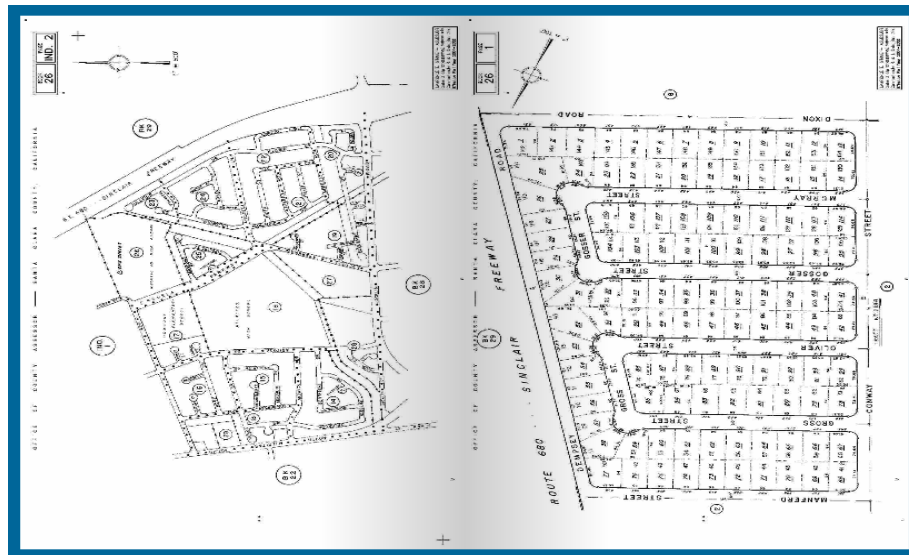- Foundation for presenting location-based information

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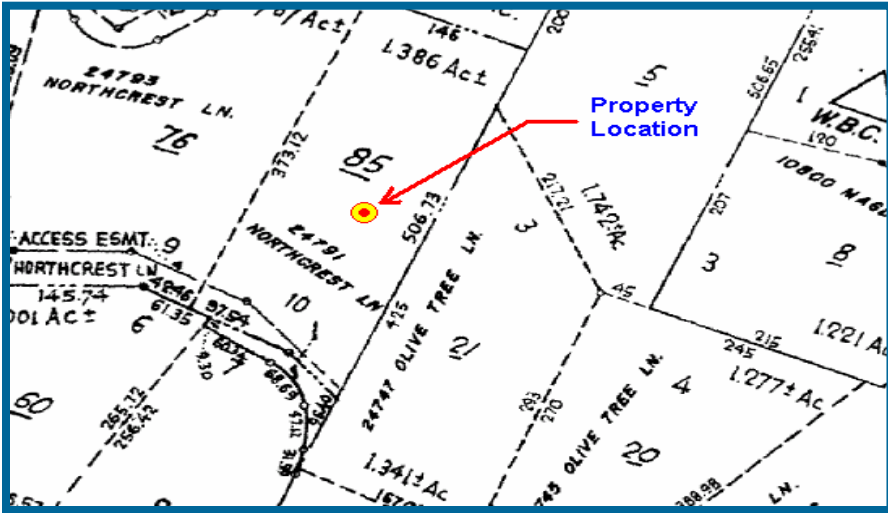
GeoMarQ – Seamless, digital parcel basemap

Parcel Maps in Flash flip-book format

The following is a partial list of specialized GTF applications:

- **SplashPoint** for the management and pinpointing businesses virtual billboards with dynamic creation and publication of business information.
- **GEODACParcelBasemap** for the management and distribution of parcel maps and data in an enterprise-wide environment.
- **GEODACUtility** for the management and pinpointing underground and above ground infrastructures such as water distribution mains, sewage lines, telecommunications, gas lines, power distribution, hydrants, and high voltage transmission lines.
- **GEODACUSA** for the management and pinpointing of Underground Service Alert digging locations
- **GEODACSearch&Rescue** for the management and pinpointing lost persons and materials in 911 emergencies
- **GEODACTracking&Monitoring** for GPS monitoring and tracking on real-time basis
- **GEODACConstruction** for the management and pinpointing constructions sites with full Project Management and Asset Management functions.
- **GEODACLand** for the management and pinpointing land features with GeoMarQ as the core parcel base mapping background layer

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What is GTF?

GEODAC is the developer of an enterprise-wide geospatial technology framework that is conceptually architected and designed by a professional engineer primarily for professionals in government and private enterprises. GTF leverages on the underlying NASA open source World Wind Technology. GTF is the foundational base for developing various applications that address specific customer needs.

GTF is robust, diverse, and easily extensible where users are accorded the capability to define functions and requirements. The Layer Manager provides connectivity to data sources located anywhere in the Internet domain. This allows users to have control of proprietary data in addition to access to public domain data such as water, gas and power, sewage lines, and telecommunications. There are compelling arguments in support of a system such as GTF where all information are collated from de-centralized or centralized sources from which residential, commercial, developers, and professionals alike can obtain and process what they need.

In a nutshell, GTF is a global precision tool used for managing and pinpointing geospatial objects. It provides solutions to customers where extreme accuracy and timeliness (space & time) are vitally important. It provides users with different levels of search options and relational information management capabilities.

GTF allows users to search and display geospatial information in a flip-book billboard like presentation that is both informative and elegant. Users can manage geospatial objects by interactively spinning around and zooming in and out of 3D view of the globe, in essence to provide much richer and more interactive souped-up billboard pages like functionality that is both informative and elegant.
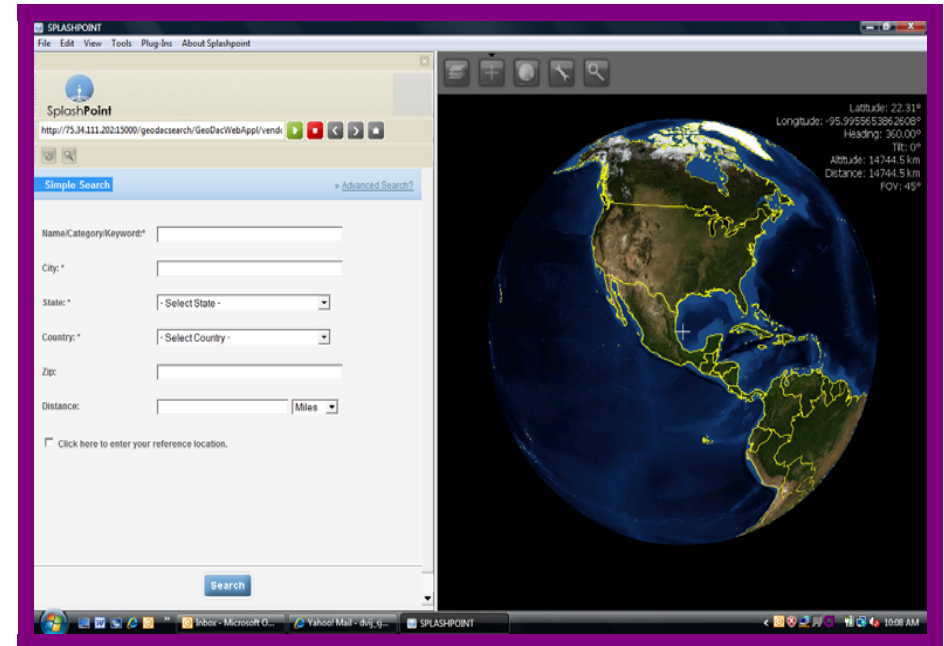
GTF has a dynamic, built-in browser-based J2EE application and a .NET application (GeoBrowser). That provides a real time seamless exchange of pertinent information between these two processing components in such a manner that the resultant composite application (GeoBrowser) provides a very potent combination in fostering a highly interactive and rich application environment.

Using the browser interface, users can perform all Search functionalities and complete management of user owned information on-line. Geospatial data and non-geospatial data are interactively managed. Geospatial attributes are presented as billboards on a flip-book format that is both informative and elegant. GTF provides users complete control over the creation and publication of information. A complete multimedia presentation with sophisticated linkages is all possible, providing a complete and comprehensive display of information.

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GTF High Level Features

- Diverse data source connectivity
- Robust Map Layering Management
- Geospatial and SQL database Backend
- Enterprise-wide Search Engine
- GPS Tracking and Monitoring capable
- Configurable Accuracy and Precision
- Robust Query Builder
- Dynamic and interactive data and mapping management
- Integrated Financial/Billing System
- Add-On Modules
  - Project Management Module
  - Engineering Computation and Analysis Module
  - Report Generation Module
  - Workflow, Scheduling, and Contract Module
  - Dynamic satellite imagery geo-coding and layering Module
  - Custom modules as per customer specification
  - Asset Management

GTF nuts and bolts capabilities

GTF supports many of the common data formats, and are not limited to the following: Arc Grid, CADRG/CIB, DEM, DLG-O, DOQ, DGN, DRG, DTED, DWG, DXF, E00, ECW, GeoTIFF, JPEG2000, KML/KMZ, Lidar LAS, MrSID, SDTS DEM, SDTS DLG, SRI Shapefiles, Tiger/Line.

GTF supports true 3D viewing of loaded elevation data including draping of any loaded imagery and vector data over the 3D surface.

GTF provides direct access to Digital Globe, GlobeXplorer, and AirPhotoUSA high resolution color satellite imagery for the entire world.

GTF provides direct access to the complete TerraServer-USA satellite imagery and topographic map archive for the entire US.

GTF provides easy, direct access to WMS data sources, including built-in access to the complete 30-m NED database, the 3-arc second world SRTM database, and color global imagery.

GTF crop, reproject, and merge any combination of raster data and elevation data, including DRGs. You can also crop data to an area feature.

DIGITIZING SUPPORT: You can digitize new vector (area, line, and point) features by drawing them with the mouse. You can also edit existing vector features. Newly created and editing features can be saved to any of the supported export formats. In addition, shapes like rectangles, circles, ellipses, arcs, and concentric range rings can be easily drawn as well.

GPS SUPPORT: You can track a compatible GPS device connected to your computer's serial port or USB port in real-time over any loaded data. In addition, you can mark waypoints at the current GPS location and record a tracklog of where your GPS device has been while connected.

PROJECTION/DATUM SUPPORT: – You can accurately convert between a large list of projection systems and datums. Custom datum conversions can be easily added in either 3-parameter or 7-parameter form if a required datum transformation is not already supported.

EXPORT SUPPORT: You can export both vector, raster, and elevation data to a variety of formats. You can merge any combination of data sets, regardless of source scale, type, and projection. You can also breakup your data into a regularly spaced grid on export.

Vector Data (i.e. DLGs, Shapefiles, DXF, etc.): Arc Ungenerate, AutoCAD DXF, CDF, CSV, DGN, ESRI Shapefile, Garmin PCX5 TRK and WPT, GPX (GPS eXchange), KML/KMZ (Google Earth), InRoads ASCII, Landmark Graphics, Lidar LAS, Lowrance USR, MapGen, MapInfo MIF/MID, MatLab, MOSS, NIMA ASC, Platte River ASCII Digitizer, PLS CADD XYZ Grid, Polish MP (cGPSMapper), Simple ASCII Text, Surfer BLN, SVG (Scalable Vector Graphic), Tsunami OVR, USGS DLG-O, WAsP .MAP

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Raster Data (i.e. imagery, scanned maps, etc.): BIL/BIP/BSQ, ECW, Erdas Imagine, GeoTIFF, KML/KMZ raster, Idrisi, JPG, JPG2000, PNG

Elevation Data (i.e. DEMs, etc.): Arc ASCII Grid, BIL, BT (Binary Terrain), DTED, DXF (3D-point, 3D-mesh, and 3D-face), Erdas Imagine, Float/Grid, Geosoft Grid, GeoTIFF DEM, Gravsoft Grid, Idrisi, Leveller Heightfield, Lidar LAS, MapMaker Terrain, Optimi Terrain, PGM Grayscale Grid, PLS CADD XYZ Grid, RockWorks Grid, STL, Surfer Grid (ASCII and binary), Terragen Terrain, USGS DEM, VRML, XYZ ASCII Grid, Zmap Plus Grid

IMAGE RECTIFICATION: You can graphically rectify (georeference) any JPG, TIFF, or PNG image and save the results to a new fully georeferenced image. Vector data can also have a rectification process applied to it after loading to allow morphing vector data to fit other data sets.

CONTOUR GENERATION: You can create contours for any combination of elevation data. You can also specify the contour interval to use. The generated contour data can then be exported to any of the supported vector export formats.

Automatic triangulation and gridding of 3D point data sets, such as ASCII XYZ files. This allows you to convert a set of elevation samples into a fully gridded data set, which can then be used for contour generation, line of sight analysis, and view shed analysis, among other things. The data can also be exported to any of the supported elevation grid formats, such as USGS DEM.

Support for combining/comparing terrain surfaces, such as DEMs. This allows you to generate a new terrain surface by combining/comparing two loaded terrain surfaces with operations like subtraction (difference), averaging, and min/max. The results can then be exported to any of the supported elevation grid formats, such as USGS DEM.

Advanced screen capture. You can capture the contents of the screen to a BMP, JPG, PNG, or (Geo) TIFF file of user-specified resolution.

Batch conversion of many input data files to any compatible export type.

Auto-clip collar for DRGs. You can now have the collar of USGS DRG files automatically clipped off. This allows you to seamlessly view a collection of adjacent DRG files.

Supports opening SDTS DLG, SDTS DEM, and most other file types directly from .tar.gz and .zip archives. This saves the major headache of decompressing each SDTS transfer into a separate directory.

Comprehensive view shed analysis using loaded elevation grid data from a user-specified location, transmitter height, and radius.

3D Path Profiling and Line of Sight (LOS) capabilities, including receiver/transmitter heights, minimum clearance, and earth curvature options.

Advanced measurement capabilities, including multi-segment path lengths and headings, enclosed area, and cut-and-fill volume calculations either along a path or within an enclosed area.

Ability to link vector feature attributes to web sites or files.

Supports opening DLG-O and DEM files directly from gzipped archives. This means that you can save space and hassle by not having to decompress the data after you download it.

Slide over text. When you move your cursor around the screen, you will get a description of the nearest feature automatically displayed in the status bar. Supports keyboard navigation.

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Technology Perspective

GTF operates on a PC with operating system as either Windows XP or Windows Vista with at least 1 GB of RAM. The technology is based on J2EE, .NET, Oracle Database and NASA World Wind open source framework. Future releases will support non-Windows environment such as Apple and Linux OS.

GTF is an integration of Java browser based application and a .NET application. The GTF application is designed with Service Oriented Architecture (SOA) as the overarching architectural approach.
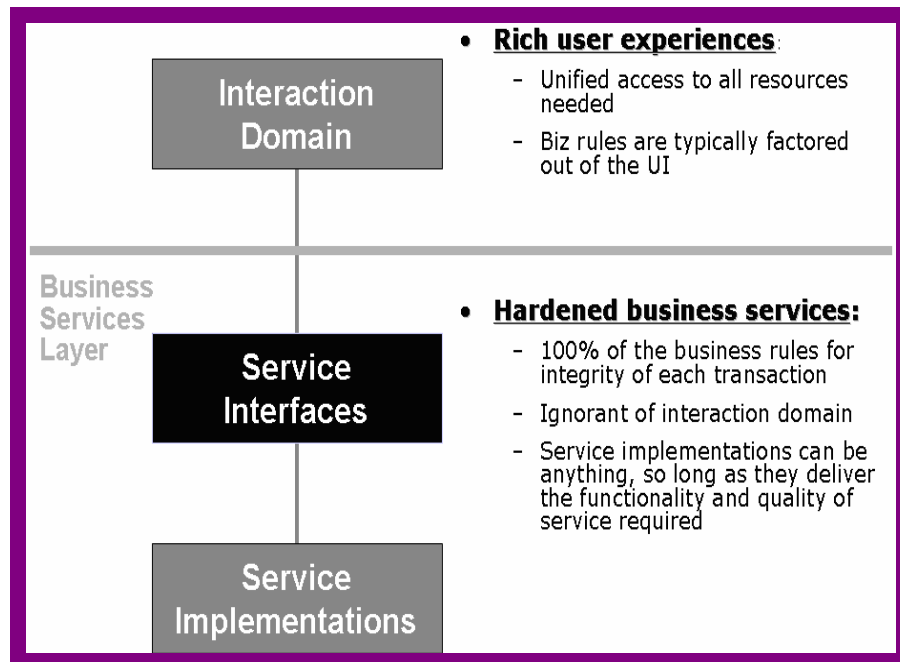
GTF Browser Pane

The browser pane portion of GTF is an HTML based client application with J2EE and well proven Struts methodology as the underlying technology set. GTF has been developed using Oracle JDeveloper IDE suite.

Application Architecture

- **Business Service Layer** implementation of the application leverages proven design patterns such as:
  - Strategy
  - Data Access Object
  - Business Delegate patterns

  These design patterns provide proven and extensible solutions to various software design problems.

- **Presentation Layer** of the application has been architected based on Apache Struts 1.2 framework. Struts based presentation layer simplifies the overall programming model by separating the programming code into three distinct areas:
  - **Model** component maintains and manages the backend business logic
  - **Views** builds the end-user presentation layer
  - **Controllers,** on the other hand, maintain the conditional logic that decides which screens are presented to the end user, what happens when errors occur, etc.

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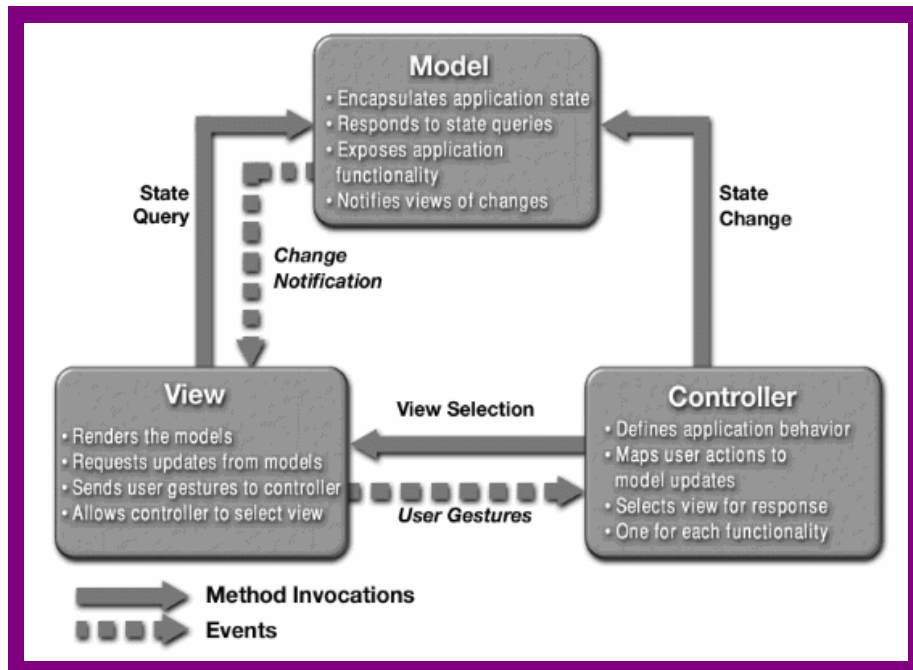
Application Functionality

The users of SplashPoint applications based on GTF are provided with various levels of Search functions:

- **Simple Search:** Using the simple search, the users can get the list of geospatial objects based on the criteria such as Name/Category/Keyword, city, state, country, zip, and distance from reference location. For turnkey operations, Simple Search can be transformed into a global, un-structured search format where users simply enter name, category, or keywords; thereby making location parameters transparent to the users. GTF simply searches and locates that object from various input combinations easily.
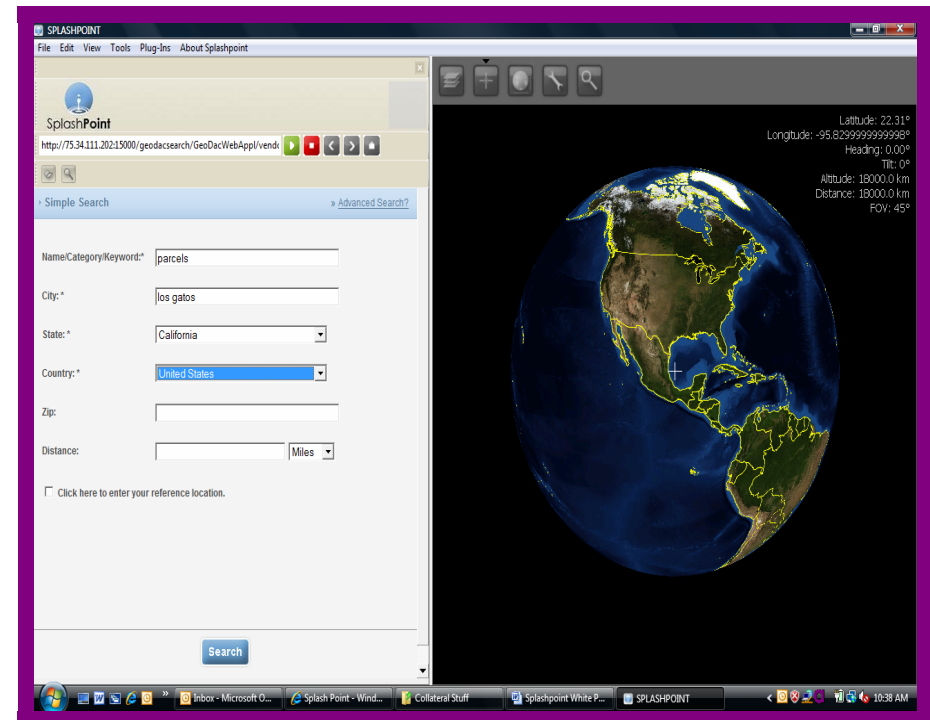
Using Simple Search form within the browser interface, users locate the geospatial objects via text based search criteria. Once located, the geospatial objects location alongside corresponding billboard information is presented within the 3D view on the globe by mapping the object location to the digitized parcel map information. Also, result of a search allows objects to be found on a 3D map and located in proximity to one another on the globe — for example, users are able to find the nearest hydrants with automatic identification of the nearest Fire Department.
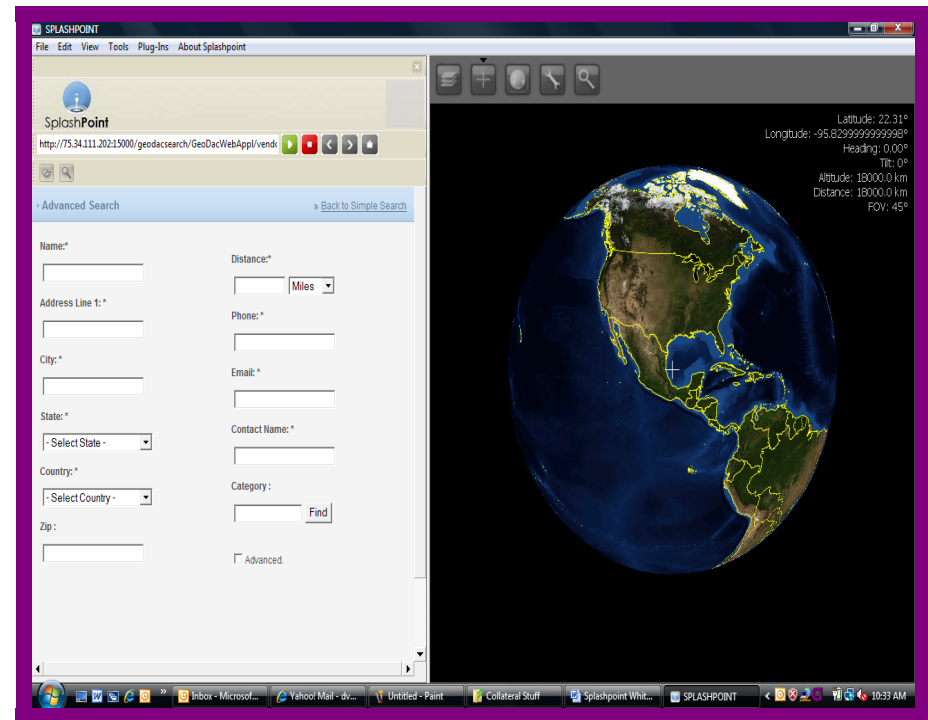
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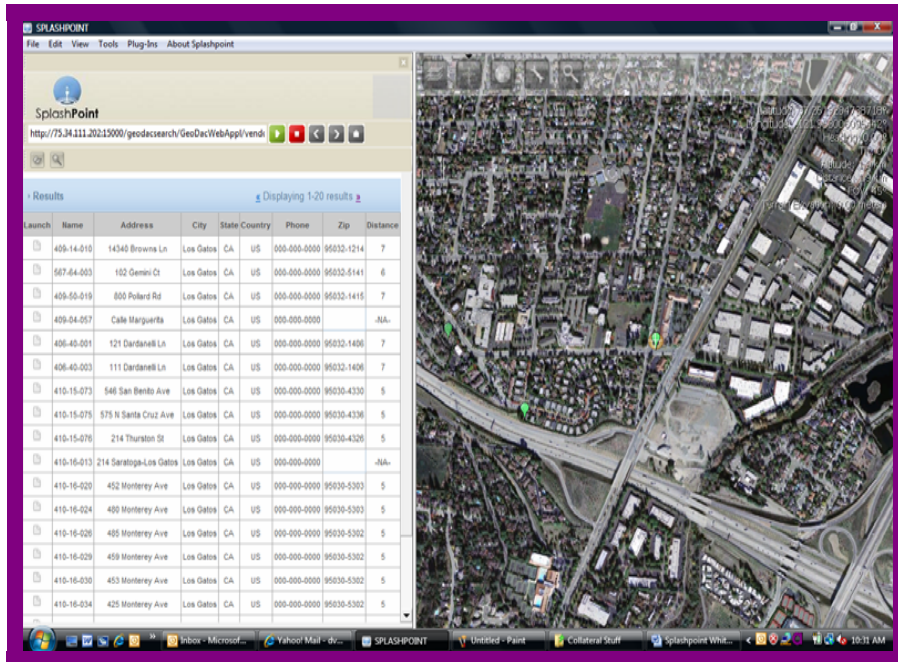
Results are displayed based on application defined fields with appropriate markers displayed on the 3D visual global map. Markers can be hyperlinked to other documents or collect mapping parameters as input to an engineering algorithm, such as the calculation of a water pressure at a given point.

- **Advanced Search:** Using the Advanced search, the users can get the list of Objects that includes additional search criteria such as Name of the Business, Address, city, state, country, zip, distance, phone number, email, contact name, category name and the reference location.
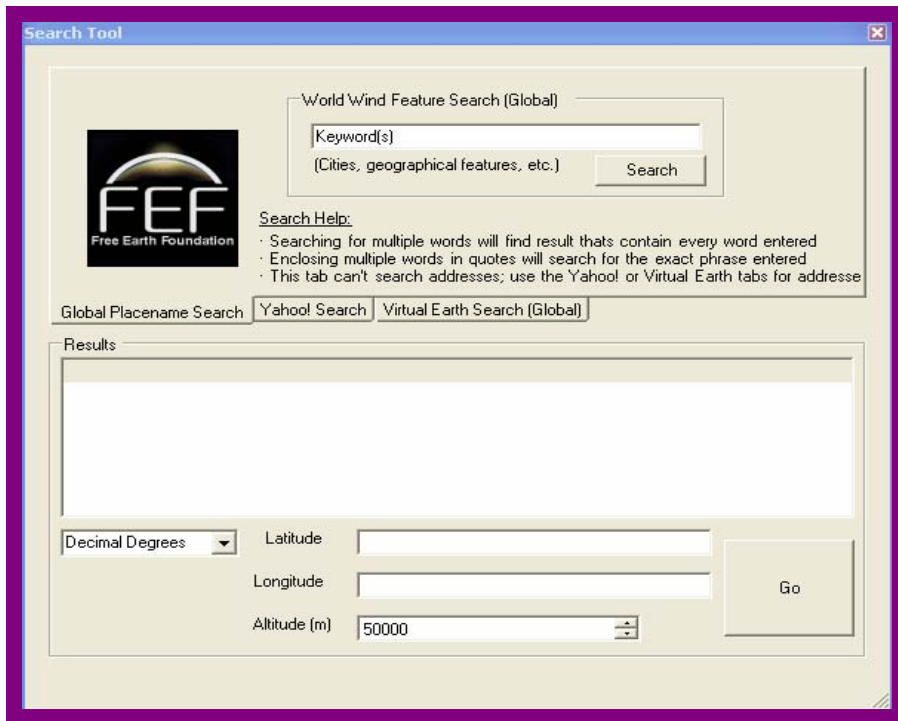
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- **Professional Search Tool:** This is a World Wind expanded search capability that allows users to define geospatial search criteria. This is customizable based on user needs. This provides search capability on the Internet and corporate enterprise data sources with simple and complex bolean geospatial queries.

- **Management Console:** Businesses or organizations can choose to subscribe to GTF to showcase and to manage their services. The following subscription options are offered:
  - ➢ Level 0: Default: a free service, which allows standard "yellow pages" type of data to be captured.
  - ➢ Level 1: This level allows one bulletin board for display.
  - ➢ Level 2: This level allows three bulletin boards for display.
  - ➢ Level 3: This level allows five bulletin boards for display.
  - ➢ Level 4. Customized as per customer needs to go beyond basic data management functions.

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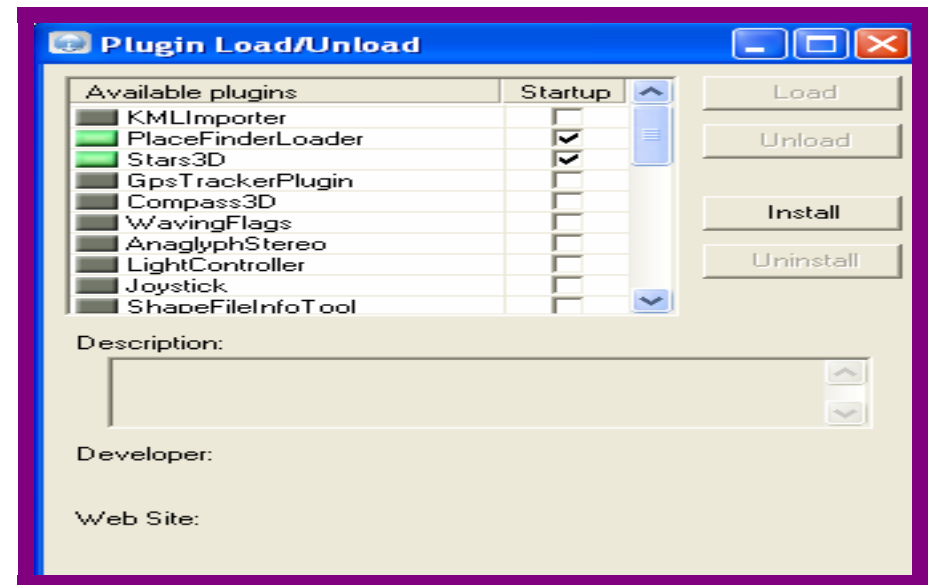
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- **Flip-Book Billboards** - Maintain Accounts, Order & Renew subscriptions, Maintain Enhanced Data including object details, maintain and view billboards in Flash flip-book technology format. Users can perform all of these functions in a Self-Service mode using the vendor management console provided by the GTF application.
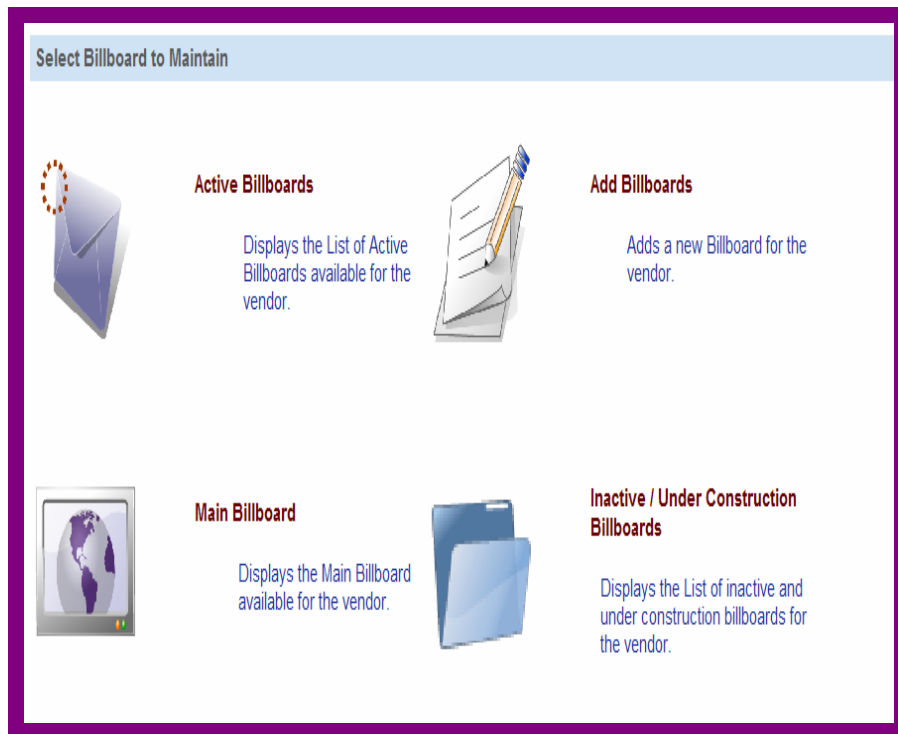
- **Plug-ins and Add-ons**. Retained World Wind core feature and undergoing expanded functionality. This allows users with programming background to locally add features and functions easily.

- **Shapefile Format Compatibility:** Retained World Wind core feature and undergoing expanded functionality. User may upload shapefiles directly to a geodatabase backend.
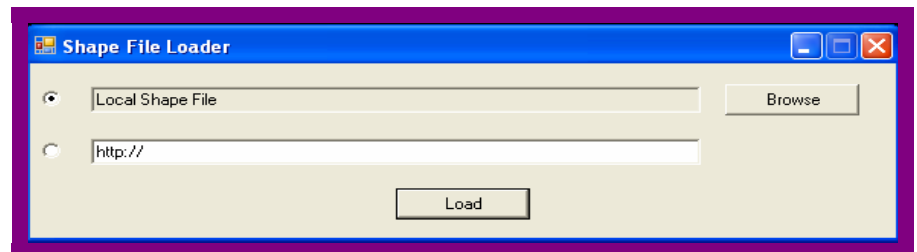
- **Similar and other related layers** can be served by remote or local WMS Servers.
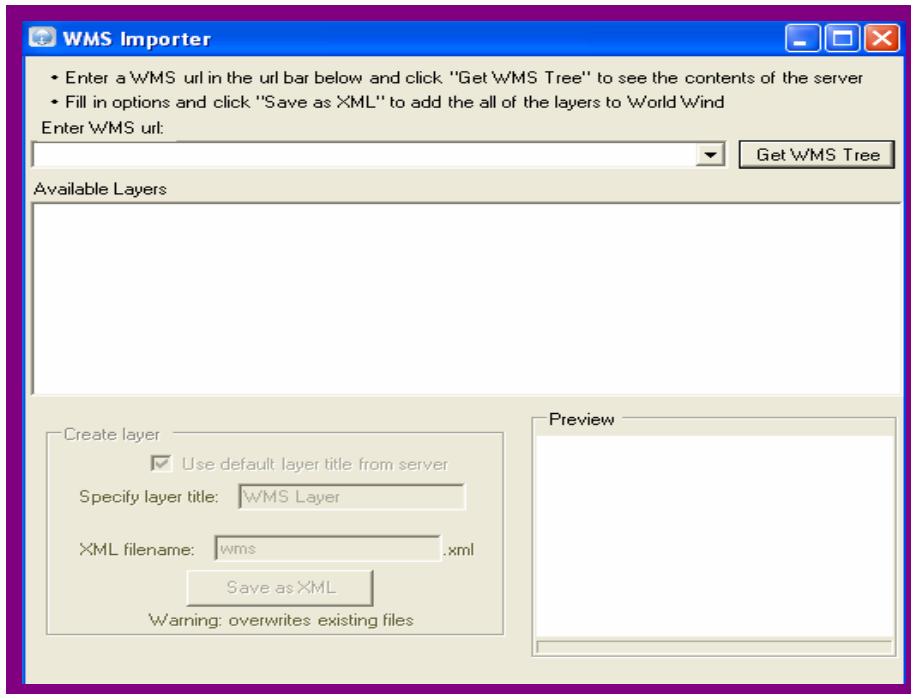
GTF 3D Globe Pane

The 3D Globe pane portion of the GTF application is a .NET application. This application is written in C# (C-Sharpe language) programming language. The application is self-deployable by click of a button, one-click deployment.

The .NET application is built on top of NASA open source 3D rendering World Wind framework. The open source nature of NASA World Wind application in conjunction with modular and expandable systems architecture allows developers to easily customize the application through plug-ins. A multitude of additions has been contributed from the open source community, which have significantly increased the capabilities of World Wind and significantly increased the available data.

NASA World Wind software solution provides interactive 3D view of the globe. World Wind is an application developed by NASA Research and Development for the NASA Learning Technologies program. World Wind is a client/server based .NET application. World Wind, in contrast to other alternatives such as Google Earth etc., is open source. The project's background in scientific visualization means it can handle more complicated tasks, and there are far more data sources built in.

Application Architecture

The GTF application allows any user to zoom from satellite altitude into any place on Earth, leveraging high resolution LandSat imagery and Shuttle Radar Topography Mission (SRTM) elevation data to experience Earth terrain (or any planet with the data) in visually rich 3D, just as if they were really there.

The user interface of the application is designed for the layperson, giving convenient access to all kinds of geographically referenced information, thereby hiding the technical details related to finding, accessing and retrieving geographic data.

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The application is straightforward enough – it requests tile coordinates from the server, then composites the results together on the client side, rendering each layer in the specified order and opacity.

The application, through its network-based architecture, can access terabytes of data from servers across the internet. However, attempting to stream this much data to the application all at once is impractical, even on the most high-speed local area networks. To address these issues, application uses a layering technique that shows progressively more detail as a user zooms in to various locations.

As a user zooms in to various locations on the Earth, the application requests the necessary data from servers across the internet, downloading only the information that is required to display the view requested by the user. In its simplest form, the application directly requests tiled imagery (images of size 512x512 in jpeg and other formats) from a server using a simple HTTP request protocol. The WMS protocol specification is also supported. It then seamlessly transitions from one Layer to the next, revealing successively more detail as user navigates around the World.

Application Functionality

The 3D Globe pane portion of GTF has a very easy-to use interface, comprised of a menu bar, a tool bar, and a view port. It has however, a very complex set of GIS tools that is expandable by users via Plug-ins and Add-ons.

- **Navigating the Globe**
  - ➤ **Panning:** There are several ways to pan (travel) to locations on the Earth on the globe.
    - ☑ Click the place you wish to pan to.
    - ☑ Click with your mouse and drag the Earth around.
  - ➤ **Zooming:** Normally you will use one of two ways to zoom in on an area of interest or back out again.
    - ☑ Click both mouse buttons and drag; up to zoom in, or down to zoom out.
    - ☑ Use your scroll-wheel to zoom in and out.
  - ➤ **Rotating:** The application allows you to see the Earth's features in 3D.
    - ☑ Zoom in far enough for the features that you wish to view to stand out.
    - ☑ Hold your right mouse button and drag downward3 to tilt the globe.
    - ☑ Holding your right mouse button and dragging up restores your original tilt.
- **Tool bar Icons**
  - ➤ **Layer Manager:** Opens up the Layer Manager.
  - ➤ **Position:** Toggles the position layer.
  - ➤ **Latitude/Longitude Lines:** Toggles the Longitude/Latitude layer.
  - ➤ **Pro Tools:** Engineering and Scientific calculations and analysis
  - ➤ **Search Tools:** Opens up the global Place Finder.

As mentioned earlier, users locate the desired geospatial objects via text based search criteria. The search result set object locations is presented within the 3D globe in the form of markers. Detail billboard information for each object, if available, can be viewed by clicking on these markers.

GTF Benefits and Unique Value Proposition

GTF provides immediate tangible benefits to users and adopters of this technology. It is far less expensive than any other options available in the market today. It is much quicker to implement a complete solution than any other means known to date. It provides a single, cohesive solution that fully encompasses an enterprise wide environment that can scale without compromising complexity, cost, and performance.

GTF was designed purposely to solve day to day challenges for professionals and management. This is achieved by providing needed information in meaningful ways through a process of breaking down undue barriers and aggregating only those data that are relevant to the issues at hand.

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GTF is derived from an open-source NASA technology that has a following of millions of dedicated technocrats world wide. This means that the core technology is constantly being improved by new ideas from experts and enthusiasts all over the world. GTF as its core database is closely aligned with the largest database in the world, Oracle, specifically for users and customers who demand only the very best and accepts nothing but being the best. GTF can support users and customers who have other legacy databases. GTF can be decoupled and remain agnostic to any underlying databases. The users choose what they need. This is flexibility that only GTF can provide.

The social and economic characteristics of GTF are, but not limited to, the following:

- Provides support to services that are essential to the community
- Solve human problems as well as technical issues
- Helps you understand your problems faster and arrive at the solution much faster
- More Cost Effective
- Fast Return on Investment
- Ties communities together
- Foundation for other services in the future
- Applicable to virtually any human activities
- Scalable to match demand
- Works on minimal configuration
- Easy to incorporate with other software solutions
- Easy to master and implement
- Will help you keep ahead of your competition
- Uses the very reliable NASA technology
- Designed by Professionals for Professionals

The combined technical power and social impact of GTF provide testimony to its unique value proposition to users and customers located anywhere in the world.

Conclusion

In conclusion, GTF is the evolution of internet technology called GeoBrowsers for placing geospatial objects on a single, unified 3D environment.

GTF is a technology framework that allows users to define the process and the objectives. Maps and information can be managed from a single geospatial database or from a multitude of heterogeneous data sources located anywhere in the enterprise or in the global internet. Maps can virtually be in any format. Information can be spatial or non-spatial. With GTF, it combines both maps and information with links enforcement and relationships. In so doing, GTF provides users to manage information in a structured fashion while allowing users to Search for information in an unstructured format. i.e. the user simply types any object in the search field and GTF will do the rest in a global scale.

This technology architecture makes GTF unique and stands beyond other products in the market today where imagination can be realized. It encompasses an integrated set of processes, as listed but not limited to the following, that can scale to meet demand:

- **Geocoding.** Perform spatial operations such as calculating distance between points or finding addresses within a boundary.
- **Visualization.** Visualize data through the combined use of markers, points, lines, numbers, words, symbols, shading, color, and a coordinate system in a rich, dynamic 3D environment.
- **Spatial analysis.** Perform a wide range of analysis that is difficult to achieve any other way. For example, we can answer simple and complex questions such as "How many customers within a mile boundary are affected when a water distribution main is disrupted and where are these customers located so that an automated notification can be issued?"

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- **Routing and location finding with precision.** Based on Lat/Long or full address, the basic questions are: "Where are the nearest gas stations from here?", "What is the quickest way to get there from where I am?" and "Where is the nearest fire hydrant or manhole from a given street corner?" These capabilities are at the center of dispatching, emergency preparedness, workflow, and customer service applications.
- **Geodemographics.** Acquire a wide range of aggregated data including buying patterns, purchasing behavior, and traffic patterns. Collect historical data for each customer.
- **Engineering calculation and analysis**. Perform engineering and scientific calculations and analysis that relates space and time.
- **Interactive and dynamic responses.** Perform the processing of near-real time or real-time external input driven devices
- **Predictive Modeling and Simulation.** Perform analysis such landscape deformation in the event of dam break or storm induced landslide.

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GEODAC has deep roots in the San Francisco Bay Area. Founder Gilbert Dalit has over 25 years of professional experience in the design, installation, computer-based mapping, and management of power utility infrastructure. The GEODAC technology team includes PhD engineers with Fortune 500 experience in electrical engineering, software development, mathematical modeling and computer simulation

Founded in 1999, San Jose-based GEODAC is the developer of the newest and most advanced concept of global mapping precision solutions. GEODAC specializes in providing niche tailored solutions to industries, businesses, professionals, government, and military, and services where extreme accuracy is a demand. GEODAC's proprietary technology was developed to meet the needs of professionals in government and private enterprises.