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# Bridging Relations of Library and Information Services with Geospatial Technologies and Geographic Information System in the Perspectives of E-Governance Readiness

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**Abstract**

The current plethora of technologies has been driving the state and citizen relations as well as ways of connecting with the crowd. Not only implementation of governance but the safety aspects of citizens are also being supported by technologies. The paper has been an effort to understand the current status of contributions of Geospatial Technologies and Geographic Information System (GIS) towards various components and levels of services, and e-Governance aspects at global level. The literature has been reviewed to catch a glimpse of the multifaceted technologies and their invading attributes in different areas of the world. The role of library and information services (LIS) has been woven along with these technologies, services and creating awareness among public.

**Keywords:** Geospatial; GIS; LIS; Management; Information system; E-Governance; India.

## Introduction

The recent times have witnessed the changing roles of geographic information systems in education, learning, and governance as well. The applications are varied especially in the form of a decision support system meant for various purposes such as analyzing geospatial data. Mehri Sedighi, (2012) found in a study, "classification and coding of the geospatial information existing in an academic library's databases were entered into a geographic information system"[20]. The use of 'ArcGIS software' and its program 'ArcMap' has also been analyzed which are based on existing needs along with various indicators.

It has been observed that there can be fruitful collaboration among the librarian/staff and the geography teachers/learners in the form of useful "creation of set of standard procedures" (Marcy M. Allen, 2008) to be utilized while gathering the metadata fetched from the paper maps is a part of library collection[15]. Such metadata is very significant for the creation of spatial data infrastructure. Such identification/creation of metadata leads towards the more visibility of map collections to the users. The mentioned project has served as a guide for other libraries due to the evolvement of a particular tested procedure, thus augmenting the visibility, usage, and proliferation of geospatial data clearing houses in particular. The role of libraries is not limited to only digital collections, such as databases, collections, and current image files but should also include the print components of their geospatial information sources.

Ennis *et al.* (2013)[1] have informed about "a single geospatial data source does not contain enough information to accurately describe the high-level geospatial information for geocoded multimedia. However, fusing several geospatial data sources together enables richer, more accurate high-level geospatial information to be tagged to the geocoded multimedia." The GIS and GPS technology are very much dependent upon the local information and databases developed with the help of open source technologies. Use of commercial, as well as open source platform in the GIS, seems beneficial in terms of flexibility and convenience. In a study (Pan J, Xu Q, Yang C., 2014)[25], the different types of GIS data update have been discussed such as:

i. raster to raster data,

ii. raster to vector data and,

iii. vector to vector data.

**Geographic information systems (GIS) and Information Centres**

The library and information services have great responsibilities towards the use of geographic information users, thus the integration of Geographic Information Systems into Academic Libraries services is inevitable (Helen Thomson, 2006)[9]. Maps, tables, and other components are the primary information keys in the libraries to serve the users. The libraries have been paying special attention towards the collections, and archiving of geospatial information (Philip Calvert, 2008)[26]. The knowledge of core geographic information systems (GIS) concepts is significant to leap into intricate aspects of such applications. The role of libraries in this regard has been prominent in providing GIS services based on GIS software. The libraries support in the form of resources and services, enhancing the GIS knowledge as well as skills. There are observations that information service providers should augment their proficiency, skills and geospatial technologies. The GIS especially the geospatial technologies have landed the librarians to sharpen their skills and competence. Such skills include knowledge to assist information seekers.

Though there are various examples of using information sources and services for GIS, yet the inclusion of GIS is also reported to be used to measure, evaluate and discern the information services. The surprising results have been presented (Bradley Wade Bishop, Lauren H Mandel, 2010; Juliet Kerico Gray *et al.*)[3,12] in methods such as analyzing the "service area populations, including facility site location and other service and resource decision making; and to manage facilities, including library use and occupancy of library study space." Among many other applications of GIS, the innovative idea of strengthening of "community-level understanding of and responses to intimate partner violence" has been identified (Christine Murray et al.)[4]

**The changing face of geographic information on the web**

Various researchers viewed the need for GIS among users for urgent access to current information (Martie Pienaar, Pieter van Brakel, 1999) as well as the sufficient means to analyze the collected data[17]. The presence of data sets to serve the meaningful purpose has been an outcome of substantial investments, also the maintenance and avoidance of duplication of data in various databases cannot be ignored which led towards the web-based GIS and exchange of information, later on. The advent and presence of Geobrowsers (The Geospatial Web, 2007) has played a great role and has opened enormous opportunities for further usage[29]. The highly used social networking platforms are also responsible for the exorbitant generation of information. There have been phases of complex and expedited implementation and management of geospatial information services (P Mazzetti *et al.*; Kumar Sidda *et al.*)[23,24]. The certain cases of integration of multisource heterogeneous geospatial and remote sensing based technologies in the field of agriculture (Gloria Bordogna, ISPRS; Di *et al.*) propagate the ideas of application of GIS in various components of social, environmental and governance system[7].

Almost a decade ago, when the GIS learning was more than an entrant in the students' curriculum and minds, Maryam Nazari and Sheila Webber (2011)[14] investigated the fundamentals and characteristics of 'geospatial information' (GI) to demonstrate users' understandings of GI facilitated learning of information literacy (IL) in the GIS discipline in the perspective of "the Grounded Theory approach" and comparing the IL competencies within the SCONUL model. The outcomes of the study stands the GI as "geo/ spatial, temporal, geo/spatially contextualised, and geo/spatially technology mediated" spotlighting it as a "constructive concept" finally becoming geo/ spatially understandable and utilized.

In the IT inclusion with the geographic information systems, the 'BioCaster Project and BioCaster Ontology' have been an important example. The study (Quoc Hung Ngo, Son Doan, Werner Winiwarter, 2012[27]) has been aimed towards seeking "an overview of the location hierarchy from the highest divisions (continents) to the lowest divisions (wards, villages) in reality and in the Wikipedia pages" along with "building a geographical ontology from Wikipedia". The extracting information and use of the same for the development of natural language processing tools have been instrumental in fetching the information of the location. The approach to find and extract location hierarchy and geographical characteristics were related to the geo-ontology and the outcomes reflect the complete geo-ontology. The efforts were made to build a geo-ontology for various territories. Such goals require the administrative estimations between various geographic locations in order to seek "real world applications". The geo-ontology is a valuable reference facilitator in building an alternative knowledge system for GIS.

**Integrating geospatial technologies and action research**

The relation of integrating geospatial technology has been found with ecological literacy. In this context, few studies have examined the action and teacher research related to environmental issues (Mary Frances Agnello, Victoria Lynn Packard, 2008)[18,30]. In this context, the collaboration between information service providers and faculties would bring fruits in case of utilization of geospatial technologies which are raised on place based educational pedagogies.

The recent developments in the arena of technologies have been instrumental in the improvement as well as the growth of patron-generated media. The availability of portable smart devices poses a great challenge to connect with the relevant information. Various approaches such as reverse 'geocoding' involve the cross-referencing of the various geospatial data sources. This leads to well-structured organization of media; hence facilitating retrieval. The design involves system architecture while aggregating multiple geospatial databases with geo-tagged media. The system is intended towards the creation of human-readable information along with the semantic information. The overall approach is facilitating the indication to the point of interest (Ennis *et al.*, 2013)[1]. A large amount of geospatial information is obtainable from multiple sources as the geospatial information discovery is made from geocoded multimedia with the instrumental role of fusion techniques.

The GIS supports in providing the bridges to the various stages of decision making keeping the users' needs in mind. Approximated a decade ago, a project handled by R.A.A. Nobrega and others has been an example in this direction[28]. They tried "to clarify the spatial multi-criteria workflow for stakeholders and decision makers" that has involved the feedback rankings in the planning phase. Their experiment has been based upon the integration of "both analytical hierarchy process (AHP) and multi-criteria decision-making (MCDM)", to aim towards the delivery of visual results. This could be made possible due to enabling the various steps such as the ranking, and prioritization of the selected alternatives. Such experiments provide the outcome in a form of automated "delivery of feasible alignments, somehow relating to the approximate which are the results of traditional approaches. The application of fuzzy theory pin computing has been instrumental in decision making in GIS as discussed (Tsai *et. al.*, 2008)[5]. The fuzzy model is applied to formulate a "decision making (TSDMK) system" which makes room and understands "inexact, linguistic, vague and uncertain GIS data" on the basis of an in-built 'intuition'.

In addition to the "integration of local planning and ancillary spatial data", there have been alignment results, which is based on remote sensing. In this context, it is worth mentioning that "spatial information technologies deliver low or high predicted environmental costs per feature criteria and cumulative predicted costs while preserving local values and plans" as stated by R.A.A. Nobrega and others [28]. There are certain techniques that are significantly transferable due to the availability of geospatial data. Such attempts provide an insight into the multi-criteria workflow while designing and setting the preference of "least environmental cost corridors".

Another example is the application of a "Geographic Information System (GIS), ArcInfo", in the cataloguing of geosciences documents held by "IRANDOC", as reported by Mehri-e-Sedighi (2007)[19]. The method involved the necessary inputs including "the attribute and spatial information". Resulting in the establishment of a vast database of the geosciences, this database has various components to support the users such as illustrating, analysing and reviewing the various

databases related to geosciences in the IRANDOC. Such endeavours extend the exercised model of the plan to support an understanding of the spatial position in similar areas. When users require the data in large volume, various depictions in the forms of maps, etc. of the spatial and subject data are found.

**Geospatial data, Interoperability and governance**

Various governances have been instrumental in the implementation and investment in "geographic and land information systems" (GIS/LIS). The sharing of data and information among the stakeholders of the governments related to geospatial data helps in good-governance. There is an uptake of information technology (IT) in the local government, such as for the property management within local government. The example of British Standard BS 7666 (as discussed in Martin Ralphs)[16] for geographical referencing has been instrumental in integrating the property management such as the Western Australian Land Information System (WALIS). To understand the 'virtual earthquakes' using the post-earthquake reconnaissance information, it has been one major area to use and provide more geospatial information. Several years ago, a report had presented the similar experience; the earthquake surveys in Asian countries (India, China, Japan, Taiwan, and Turkey) as discussed in the "first Mosaic report on the 1995 Hyogoken Nanbu, Japan earthquake" (Jean-Pierre Bardet, Fang Liu, 2010)[10]. The study provided certain insights into the post earthquake reconnaissance (PER) as well as the exchange of information based on global positioning systems (GPS) along with digital devices. The information technology assembles the information gathered from digital pictures in the form of metadata.

The usage and production of geospatial data is one of the major factors behind the integration and management of geo-data due to heterogeneous format. The geospatial data has semantic variations and conflicts due to the nature and understanding of persons in various communities. The need to establish interaction depends upon the integrity of geospatial data among organizations, raising the requirement of a framework to understand and solve the semantic data conflicts in order to augment the interoperability. The role of ontology is always in the visualizations. In this context, the endeavours made by Mohammad Shahadat Hossain and Rashed Mustafa, (2007)[21] in the form of "ontology based architecture" have been instrumental in interoperability matters and resolving the semantic conflicts by reducing the computational time. They also suggested developing a "global community, consisting of an integrator, global schema, and common ontology."

The time has witnessed the various capabilities of geospatial analysis in decision making, and business mapping. It has emerged as a great tool in supporting role especially in tourism geography. The collection of data through GIS helps in tourist consumer research (Johannes Luberichs, Helmut Wachowiak, 2010)[11]. Geospatial technologies can be given a major role in motivating the tourism industry. The geospatial information system is useful in various areas such as enhancing the tourism experiences; collaboration among the airline sector (supply chain management); and the environmental issues at the centre.

**Online social networks and GIS Application**

While understanding the population projections and distribution in geographical regions are always in discussion due to certain reasons such as marketing campaigns, etc. the highly used social media in the form of online social network (OSN) apps are playing a supportive role in devising the smart approach to find out the relation between the population and online social networks. There have been studies to establish the relationship between population distribution and online social media by "modelling geo-homophily". The recent study (Zhang, 2017) has tried to estimate "a three-layered theoretic framework" by the mechanism of measuring the diffusion of an online message by mapping among close groups[31]. These close groups are fixed and distributed in the offline communities in a set division of geographical region via a "Dirichlet process". The experiments done in the study over large-scale OSN data sets has brought knowledge to surface that "the proposed prediction models have high prediction accuracy in characterizing the process of how the population distribution forms and how the floating population changes over time". The role of GIS in tourism has been explored up to a greater extent considering the network of intra-continent tourism destinations (Antti Haahti, *et al.*) in the form of network analysis[2]. This kind of research has led to mapping and understanding the geometry of connections among the various locations. In this context, Davide Provenzano, Bartosz Hawelka and Rodolfo Baggio, (2018), with the help of geo-located twitter data

information about the "shift towards an increased homogeneity in the travelling preferences" along with the "tendency of mobility patterns to merge", in their study[6]. Such findings support the creation of insights for tourism planning (Antti Haahti, *et al.*) by establishing the outcomes of comparing the "topological structure and bilateral mobility patterns of tourism flows".

**E-Governance Readiness and Geospatial technologies**

The geospatial technologies have been instrumental in implementing the e-governance application and projects in various states and countries. The application of geospatial technologies has been towards bringing out the transparent and responsive government through service delivery in the perspectives of altering scales of geographic locations for the citizens. The aims of process reengineering are being dealt with through factors such as the digital divide, technical knowledge, and digital presence, and are ubiquitous in our environment. The basic component of state machinery is municipalities, in city and town areas. These municipal organizations have been endeavouring to facilitate the accessibility and services by eliminating the middlemen from the scenario. This 'disintermediation' is being removed between the citizens and respective governments. There have been various models which have different stages of geospatial adoptions and e-governance functionalities in terms of the following aspects:

a. Business to Business (B2B)

b. Government to Government (G2G)

c. Business to Government (B2G)

d. Government to Citizens (G2C)

e. Government to Business (G2B)

Apart from the models represented by Gartner Group, World Bank (WB) etc., the United Nations "five stage web-based public service delivery models" has been considered as a guiding force to understand the service delivery stages with the key stages such as Elementary (L1), Medium (L2), Good (L3), Advanced (L4), and Futuristic (L5) in nature and definition. These levels are related to web presence, detailed information on the web, interactive and transactional web presence for establishing connectivity between users along with seamless web presence on the networked system.

The relation of geospatial data and e-governance at the local level is reflected by the GIS application to suffice the mapping needs for policy formulation and publication purpose (Morgan and LaFary, 2009)[22]. The GIS applications are unmatched in forcing unparalleled power in the public sector. The applications are efficient for understanding and examining the "social, economic and political circumstances" (Haque, 2001)[8]. From initiating querying and the generously displaying applications to advanced modelling and analytical predictions are the key factors for successful implementation of GIS applications at local government in "Building Approval, Land Parcel Management, Zoning & Development, Town Planning Schemes, Urban Renewal, Master Plan, Integrated Development Plans, City Development Plans, Spatial Plans, Structure Plans, Project Development and Management, Slum Development, Community Planning etc." (Lewis and Ogra, 2010)[13]. The other application areas are related to resource mobilization. The following components of local governance are included, such as:

a. Property Tax System and Asset Management,

b. Complaint and grievances management system,

c. Traffic & Transportation/ fines, etc.

The very significant and interactive area is the service delivery to the citizens including Water Supply Management, Waste Management like Sewerage, Drainage, etc. The routine services include the management of street lighting, etc. in the urban governance, due to the integration of GIS. The dimensions of e-Governance are governed by the GIS application in various strata of states in administration and functionalities. There are certain levels of E-governance services such as the maturity of the services depends on the type of service. For example, water and electricity supply management, building mapping and plans, etc. are at an advanced stage yet there are basic services which are witnessing the nascent stages of e-governance applications.

The common citizen should be the ultimate receiver of the benefits of the GIS applications which have been incorporated in state governance mechanisms implemented by various agencies such as:

a. NIC

b. Department of Science and Technology

c. MoES (Ministry of Earth Sciences)

d. Survey of India

e. Ministry of Mines, etc.

These agencies have been busy in integrating and

leveraging the technologies for the advantages of services by data creation, usage, sharing & access. To implement programs there have been certain key policies set by the Government of India as:

a. National Map Policy, 2005

b. Remote Sensing Data Policy: 2001 and 2011

c. CAR, 2010 for Aerial Survey

d. The Delhi Geographical Spatial Data Infrastructure (Management, Control, Administration, Security and Safety) Act, 2011

e. National Data Sharing and Availability Policy (NDSAP), 2012

In this area, NICMAPS of NIC are in the form of "National GIS Framework" for E-governance at the Seamless Country wide base maps etc. The NIC GIS has web portal for "Remote Sensing and Geographic Information System" at (http://gis.nic.in/home.html) providing. Village Level Mapping of Demography and Amenities, Sports Facilities in Delhi, Rural Post Office Mapping, National Atlas, Parliamentary and Assembly Constituency Maps, and National Agricultural Market Atlas. Another example is web-based GIS tool, 'Bhuvan', developed by National Remote Sensing Centre (NRSC) long ago in 2009 to facilitate Disaster support services (Domestic and International). This multiple platform of services is based on 'Free satellite data' providing download facilities in various Indian languages. Other major facilitators are Indian National GIS Organization (INGO- 2011), "Open Data Platforms (http://www.data.gov.in) and many more have been serving the citizens. The web-based platforms and services are emerging in various areas at state level.

## Conclusion

The information services are the methods to outreach the common people of any country; the GIS and web-based geospatial information are the major components in the e-governance. The increasing scope of libraries and information services has been adaptive and serving the geography related information. The current demands are in the areas of training of library staff, creating awareness of various tools among common people and services by the governments at the national and state levels. The induction of such knowledge as well as usage of various services, are the facets of the system of information, geography and governance in a vast country like India.

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