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EMPOWERING GIS WITH BIG DATA

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ABSTRACT

Over the past few decades, GIS technology has become increasingly important for managing and analyzing large amounts of geographical data. However, as the volume and complexity of big data continues to grow, it has become more difficult to store, process, and analyze the data effectively. As a result, there is a growing interest in the use of big data and GIS across academia, industry, government, and other sectors.

In this paper, I review previous studies that explore the integration of big data and GIS in various applications. By analyzing big data, decision-makers can gain insights that help them decisions.

KEYWORDS: Big data, GIS.

INTRODUCTION

"Empowering GIS with Big Data" [1] refers to the integration of large amounts of data into Geographic Information Systems (GIS) [2] to enhance the capabilities of these systems in terms of analysis and decision-making. By incorporating big data into GIS, organizations can gain insights and make informed decisions based on the relationships between geographical locations and large amounts of data such as demographic information, social media, sensor data, and more. This integration also enables the creation of new data-driven maps and visualizations, providing a more comprehensive understanding of patterns and trends in specific locations. Ultimately, empowering GIS with big data leads to improved decision-making, increased efficiency, and a more informed understanding of geographic information.

GIS (Geographic Information Systems) and Big Data [3] are two distinct fields that have complementary strengths and can be combined to provide a more comprehensive understanding of geographic information. GIS is a computer-based tool used to store, manipulate, analyze, and display geographical information, while big data refers to large, complex datasets that require advanced techniques and technologies to process and analyze. By integrating big data into GIS, organizations can gain insights into relationships between geographical locations and large amounts of data, such as demographic information, sensor data, social media, and more. This integration enables GIS to analyze and visualize big data in new ways, providing a more comprehensive understanding of patterns, trends, and relationships in specific locations. Ultimately, combining GIS and big data leads to improved decision-making and increased efficiency in various industries and domains.

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HOW GIS WORKS WITH BIG DATA [2]

GIS works with big data by utilizing specialized software [4, 5] and tools to process, analyze, and visualize large amounts of data in the context of geographic locations. This process typically involves the following steps:

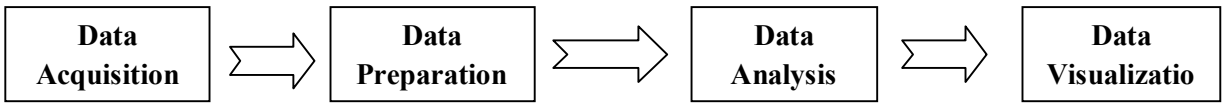
Data Acquisition: The first step is to obtain and gather the big data, which may come from various sources such as sensors, social media, demographic databases, and more.

Data Preparation: The next step is to prepare the data for analysis, which may involve cleaning, transforming, and integrating the data into a format that can be used by GIS.

Data Analysis: Once the data is prepared, it can be analyzed using GIS tools and techniques, such as spatial analysis, network analysis, and visualization. These tools allow the identification of patterns, trends, and relationships between the data and geography.

Data Visualization: The final step is to display the results of the analysis through maps, charts, and other visualizations that provide a comprehensive understanding of the relationships between the big data and geographic locations.

By integrating big data into GIS, organizations can gain new insights and make informed decisions based on the relationships between geographical locations and large amounts of data. The combination of GIS and big data leads to improved decision-making, increased efficiency, and a more informed understanding of geographic information.



BIG DATA HELPS MAXIMIZE SPATIAL ANALYSIS FOR PREDICTIVE MODELING[6,7]

Big data can help maximize spatial analysis for predictive modeling by providing a large and diverse data source that can be used to develop more accurate and sophisticated predictive models. The following are some ways in which big data can enhance spatial analysis for predictive modeling:

Increased data volume: Big data provides a large and diverse data source, which can be used to develop more accurate and sophisticated predictive models. The more data that is available, the better the model can be at predicting outcomes.

Improved data quality: Big data often contains a high volume of accurate and up-to-date data, which can be used to improve the quality of the predictive models.

Enhanced spatial resolution: Big data often contains data from various sources such as sensors, social media, and other sources, which can provide a high level of spatial resolution. This can be used to develop predictive models that have a more fine-grained understanding of the relationships between the data and geography.

Improved data integration: Big data can be integrated with other data sources, such as GIS data, to provide a more comprehensive understanding of the relationships between the data and geography. This integration can be used to develop predictive models that take into account the relationships between the data and geography.

APPLICATION AREAS [8-9]

The Big Data approach to GIS allows analysis and decision making from huge datasets, by using algorithms, query processing and spatiotemporal data mining. In simple words, this means extracting information from maximum possible

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sources using established procedures and computational techniques.

Geospatial Technology has applied big data for enhanced analysis in a variety of industries and domains, including:

Environmental management: Big data is used to track environmental phenomena, such as air and water pollution, to help organizations make informed decisions about environmental management.

Urban planning: Big data is used to analyze population density, transportation patterns, and other urban data to help organizations make informed decisions about urban planning and development.

Natural resource management: Big data is used to monitor and analyze the distribution and abundance of natural resources, such as forests and water, to help organizations make informed decisions about natural resource management.

Disaster response: Big data is used to track and respond to natural disasters, such as hurricanes and earthquakes, to help organizations coordinate their response and provide assistance to those in need.

Location-based services: Big data is used to analyze consumer behavior and provide location-based services, such as personalized recommendations and targeted advertising, to help organizations better understand and reach their target audience.

Agriculture: Big data is used to monitor and analyze agricultural production and trends, such as crop yields and soil conditions, to help organizations make informed decisions about agriculture and food production.

Real estate: Big data is used to analyze real estate markets, such as property prices and rental trends, to help organizations make informed decisions about real estate investment and development.

These are just a few examples of the many areas where geospatial technology has applied big data for enhanced analysis like Climate modeling and analysis, Location analytics, Retail and Ecommerce, Intelligence gathering, Terrorist financing, Aviation industry, Disease surveillance, Disaster response, Political campaigns and elections , Banking Insurance and Fraud analysis etc By integrating big data into geospatial technology, organizations can gain new insights and make informed decisions based on the relationships between geographical locations and large amounts of data.

CASE STUDIES

Here are some case studies that highlight the use of GIS and big data:

Location-Based Services: Foursquare [10], a location-based services company uses GIS and big data to provide personalized recommendations and targeted advertising to users. The company uses data from users' check-ins and searches, along with data from other sources such as weather and demographic data, to provide a more complete understanding of users' preferences and behaviors.

Hurricane Response and Recovery: After Hurricane Harvey hit Texas in 2017, the National Oceanic and Atmospheric Administration (NOAA) [11] used GIS and big data to analyze the extent of the damage and guide response and recovery efforts. By integrating data from various sources such as satellite imagery, social media, and flood models, they were able to provide a comprehensive understanding of the impact of the hurricane.

Urban Planning and Development: The city of Boston [12] used GIS and big data to analyze various urban data, such as transportation patterns, population density, and real estate

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trends, to inform their urban planning and development efforts. The city's data platform integrates data from multiple sources to provide a comprehensive understanding of the city and help decision-makers make informed decisions about urban development.

Natural Resource Management: The National Park Service [13] uses GIS and big data to monitor and manage national parks and other protected lands. By integrating data from various sources, such as satellite imagery, weather data, and wildlife tracking, they are able to better understand the impact of various factors on these lands and make informed decisions about their management.

These are just a few examples of the many ways that GIS and big data are being used to solve real-world problems. By integrating big data into GIS, organizations can gain new insights and make informed decisions based on the relationships between geographical locations and large amounts of data.

Agricultural Planning [14]: The Brazilian Ministry of Agriculture uses GIS and big data to monitor and analyze the country's agricultural production, such as crop yields and soil conditions. By integrating data from various sources, such as satellite imagery, weather data, and agricultural statistics, they are able to better understand the impact of various factors on agriculture and make informed decisions about agricultural planning and policy.

Environmental Management: The European Environment Agency uses GIS and big data[15] to track environmental phenomena, such as air and water pollution, to help organizations make informed decisions about environmental management. By integrating data from various sources, such as satellite imagery, sensor networks, and environmental monitoring stations, they are able to provide a comprehensive understanding of the environment and help decision-makers make informed decisions about environmental policy.

Disaster Response: The Red Cross[16] uses GIS and big data to respond to natural disasters, such as earthquakes and hurricanes, to help organizations coordinate their response and provide assistance to those in need. By integrating data from various sources, such as satellite imagery, social media, and weather data, they are able to provide a comprehensive understanding of the impact of a disaster and respond more effectively.

Healthcare: The Centers for Disease Control and Prevention (CDC) [17] uses GIS and big data to track and respond to outbreaks of infectious diseases, such as the flu and COVID-19. By integrating data from various sources, such as electronic health records, social media, and laboratory results, they are able to track the spread of a disease and respond more effectively.

These case studies show how GIS and big data are being used to solve real-world problems and provide new insights into complex issues. By integrating big data into GIS, organizations can gain a more comprehensive understanding of the relationships between geographical locations and large amounts of data, and make more informed decisions.

CONCLUSION

Big Data can help maximize spatial analysis for predictive modeling by providing a large and diverse data source, improving data quality, enhancing spatial resolution, and improving data integration. These enhancements lead to more accurate and sophisticated predictive models, which can be used to make more informed decisions. The convergence of GIS with big data means that the potential applications of the two will become limitless

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