

UNLOCKING THE POTENTIAL OF GEOAI: A PATH TO ADDRESSING GLOBAL CHALLENGES ACROSS MULTIPLE DISCIPLINES

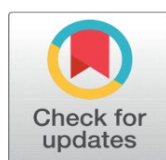
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ABSTRACT

The idea of Stan Openshaw and Christine Openshaw “Let the data speak for themselves” is vision of progress as the human predictions and analytical work is to be done by data collected itself “the data should speak by itself” with factor of artificial intelligence (A.I). The research aims to create an account of evolution and development in the field of geographic prediction and analysis. The research revolves around the development of artificial intelligence in the geography and its integration process. The field of geography and its interdisciplinary have a dynamic strategy and endured scope of development and how it will affect the current world, settlement, human occupation and specially in the field of economics which directly show its dynamic change on human living and environment balance.

The applicable changes in Health sector, Mapping and Cartography, Research work, Environment epidemiology, Urban planning, Resource management, Fluid resource distribution, Population distribution and Environment science are presented here with an account of statement of geographer from various sources like journals, research paper and conference proceedings and statements. The engineering scope and geographic background are going to discuss together the futuristic infrastructure and co-operative institute with ideas presented by each other to maintain a prosperous Environment.

Keywords: GeoAI, Geography, Development, Human Population, Geospatial Science, Disaster Risk Reduction.



1. INTRODUCTION

GeoAI, which stands for Geographic Artificial Intelligence, is a field concerned with the use of artificial intelligence (AI) to understand, analyse, and manage geographic or spatial data (Muin & Rakuasa, 2023). This geographic data includes information that has a location component or geographic coordinates, such as maps, satellite images, GPS data, and more (Kurniadi et al., 2019. Anastasia Amponsah et al, Sept 2023). GeoAI combines elements of AI, such as machine learning, deep learning, and data analytics, with geospatial science to produce deeper understanding and accurate predictions of real-world phenomena. One of the main applications of GeoAI is in environmental mapping and monitoring. GeoAI, or geospatial artificial intelligence, is an exciting new area that leverages artificial intelligence (AI), geospatial big data and massive computing power to solve problems in high automation and intelligence (Li 2020; 2021). GeoAI, or geospatial

artificial intelligence, is an exciting new area that leverages artificial intelligence (AI), geospatial big data and massive computing power to solve problems in high automation and intelligence (Li 2020; 2021). The term was first coined at an Association for Computing Machinery (ACM) workshop in 2017 and then quickly picked up by industry giants Microsoft and Esri for providing new ways of analysing geospatial data in a cloud environment. (Wenwen Li, Jan 2023)

Anastassios Dardas stated that GeoAI can be best thought of as a blend of narrow artificial intelligence (AI) and applied spatial science, often referred to as geographic information systems (GIS). Narrow AI is a type of AI that is focused on very specific (or narrow) task. On the other hand, GIS is an applied science within the field of geography that projects the physical world onto digital map layers for various applications. GIS itself is used in a wide range of the fields including business, biology, urban planning, epidemiology, defence , and even dentistry, or basically any domain where problems have an inherent spatial component.

2. OBJECTIVES

- The study aims to create an attention between teachers and institutions to develop the concept of artificial intelligence across multiple disciplines.
- The study aims to highlight the integration of A.I in geography.
- The motive of research developed the importance and scope of a.i in geography.
- The research deals with integration AI applications in the geography.

3. METHODOLOGY

The methodology of present work will include secondary data and the data is collected from secondary sources like research papers and case studies from various countries like Tomsk(Russia), Kuwait , Ireland , and associations like ESCAP, and etc. The research has an inductive approach in which we had highlighted the information from the statement of various scholars and attempt to show their application, with realistic applicable nature and multidisciplinary uses and interdisciplinary adaptability.

4. THE CONCEPT AND EVOLUTION OF GIS

The concept of GIS was developed by Anglo-Canadian [Roger Tomlinson](#). One year later, [Howard Fisher](#) at North western University developed the first GIS operational software. With the development of spatial prediction methods and the concept of GIS, we can arguably say that GeoAI has its roots as early as the mid-1960s, which is a mere decade after [Alan Turing developed his famous AI Test](#).

Esri's first generation software, ArcInfo, was one of the first commercial GIS products, released initially in [1982](#) and ran on a prime minicomputer with connected graphics terminals. ArcView was the first official window-based desktop software with version 1.0 released by Esri in [1991](#), leading to much more widespread use of GIS via the Microsoft Windows (and also Unix and Mac 9) OS through to its ultimate version 3.x in 2002. Esri's third desktop software, ArcMap, had its first release in [1999](#), eventually replacing ArcView by the early 2000s. The majority of GIS software development has been towards Web and enterprise-based solutions. Organizations use ArcGIS Online and ArcGIS Enterprise to manage and analyse "big" geospatial data and display interactive Web maps as the output. Both solutions have a suite of ArcGIS apps for specific use cases (e.g., Operations Dashboard, Story Maps , Tracker, Survey123, ArcGIS Insights). ArcMap continues to be used as the predominant GIS desktop, but ArcGIS Pro is becoming more popular, especially since it has out-of-the-box deep learning tools, the integration of Notebooks to explore spatial data science, and the ability to process "big" data through a direct connection to Geo Analytics Server.

3G GeoAI changed greatly the GIS ecosystem, there are new technologies and applications on the horizon that promise more dramatic advancements in GeoAI. For instance, Internet of Things (IoT) devices and drones are the next frontiers for "big" data collection. Real time data will supplement deep learning and data science approaches and open new use cases and analytics, such as smart cities and semantics.

It is unclear what the next ML technology will be, however it is clear that there will be widespread use of generative adversarial networks (GANs), reinforcement learning, and transfer learning. These types of learning algorithms, and how they are applied in GIS, will be discussed later on in this blog series (particularly transfer learning). Other emerging ML technologies are natural language processing (NLP) and semantic AI. (Anastassios Dardas; July 2020)

5. THE CONCEPT OF ARTIFICIAL INTELLIGENCE IN GEOGRAPHY

The use of AI techniques in geography and the earth sciences as such is not new. Openshaw's 1997 book on Artificial Intelligence in Geography serves as a prominent example (Openshaw and Openshaw 1997). Even before, Couclelis (Couclelis 1986) and Smith (Smith 1984) discussed the potential role of AI for geographic problem-solving in the 80s. What has changed since those early days cannot merely be attributed to novel computing architectures and advanced methods such as Generative Adversarial Networks (Goodfellow et al. 2014).

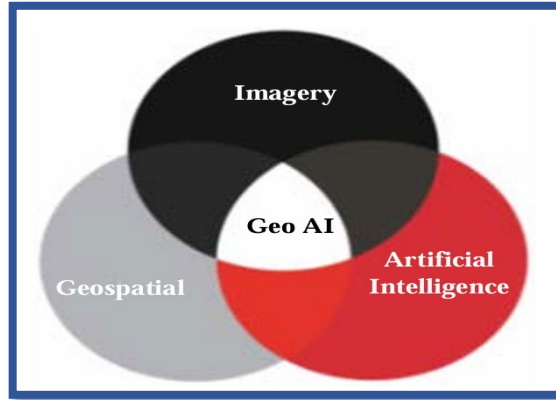


FIG 1 : GEOAI CONCEPT (SOURCES :A. I. Alastal, A. H. Shaqfa Kuwait, Case Study)

The concept of automated geography was introduced by Jerome. E Dobson in his research which he states the changes and requirement of changes in the learning and analysis of geographic data and stated the changes in research work , analytical work and to give human prediction and to make simple work for humans in the field of geography. Dobson's "Automated Geography" (Fennernan, N. M) and a set of eight invited commentaries, also published in The PG (Dobson et al,1982), had addressed extensively the role of computers in research, theory development, methodology, and application. In that debate, Dobson's confidence in automation as an integrative and progressive force in geography was countered in the commentaries by considerable, albeit qualified, scepticism, and a nearly unanimous conviction that the computer is a tool and a tool only. "What are geographers doing with computers that is really new and different? Regretfully, the answer appears to us to be very little at present," write Marble and Peuquet (127, p. 3431) who later add, "developments can arise only out of unexploited bodies of theory." The discussion was initiated by Smith (Smith, T. R. 1984) who contributed a very informative paper on "Artificial Intelligence and Its Applicability to Geographical Problem Solving." This paper was immediately followed by a response by Nystuen (Nystuen, John. D) who, while welcoming the novelty in principle, cautioned against excessive claims for the approach and expressed concern for its apparent theoretical poverty.

6. ADVANCEMENT IN GEOAI

The **rapid advances of GeoAI** in both academia and industry are attributed to three factors: (1) the proliferation of geospatial big data has provided abundant information for researchers to study the environment and society; (2) the recent breakthrough in AI and machine learning (especially deep learning) has better positioned AI for complex and real world problems; and (3) the fast developments in computing technology, such as Graphics Processing Unit computing, have made it possible to run compute-intensive models using big data. GeoAI evolves as AI evolves, but it is not simply an application of AI in geography. (Wemen li, Jan 2023)

GeoAI is a combination of AI and Geography and it evolves as AI research develops. AI, a current buzzword, is about developing machine intelligence that mimics the way humans recognize and reason about the world. Machine learning is a subset of AI. Different from other general algorithms, machine learning algorithms have the ability to learn the mapping from input data to the output results without the need for explicitly programming the analytical rules. (Wemen li , Jan 2023)

Recent advances in analytical methods and computer technology have made automation possible for almost every scientific procedure that heretofore was per- formed manually in geographic research and problem solving. Computer

cartography, computer graphics, digital remote sensing, geographic information systems, spatial statistics, and quantitative spatial modelling have advanced rapidly. As a result it is now possible to perform geographic analyses of complex problems for areas of continental size with data resolution designed to meet the inherent needs of the problem. Small computer systems are widely available to facilitate the study of small, less complex problems. Few scientists, policy makers, and business managers are aware of the implications for geographic studies addressing corporate or public policy issues at the local, regional, national, and international levels. The potential for aiding basic and applied geographic research has barely been tapped. (Jerome E. Dobson, 1983)

7. POTENTIAL OF GEOAI IN HEALTH SECTOR

The potential development of GeoAI (Artificial Intelligence based on geospatial data) technology in the health sector is very promising and has a significant positive impact. First, GeoAI can be used for disease monitoring and prediction. By utilizing geospatial data such as patient location, population movement patterns, and environmental factors, GeoAI can help in detecting and forecasting the spread of diseases more accurately (Janowicz et al., 2022). This is particularly important in the face of infectious disease outbreaks such as pandemics, enabling a faster and more effective response. Secondly, GeoAI also supports better planning of health facilities. With geospatial data analysis, GeoAI can assist governments and health agencies in determining the optimal locations to build hospitals, health centers, or other medical facilities (Mesko, 2017). This can improve the accessibility of health services for the community, especially in remote areas or those that require more emergency health care. The basic concept of GeoAI involves collecting geographic data such as maps, satellite images, and weather data, which are then analysed by AI algorithms to identify health-related patterns, relationships, and trends (Mesko, 2017). GeoAI can help in monitoring the spread of infectious diseases, predicting disease incidence, mapping health resources, and understanding health behavior patterns based on location (Kaur et al., 2021)

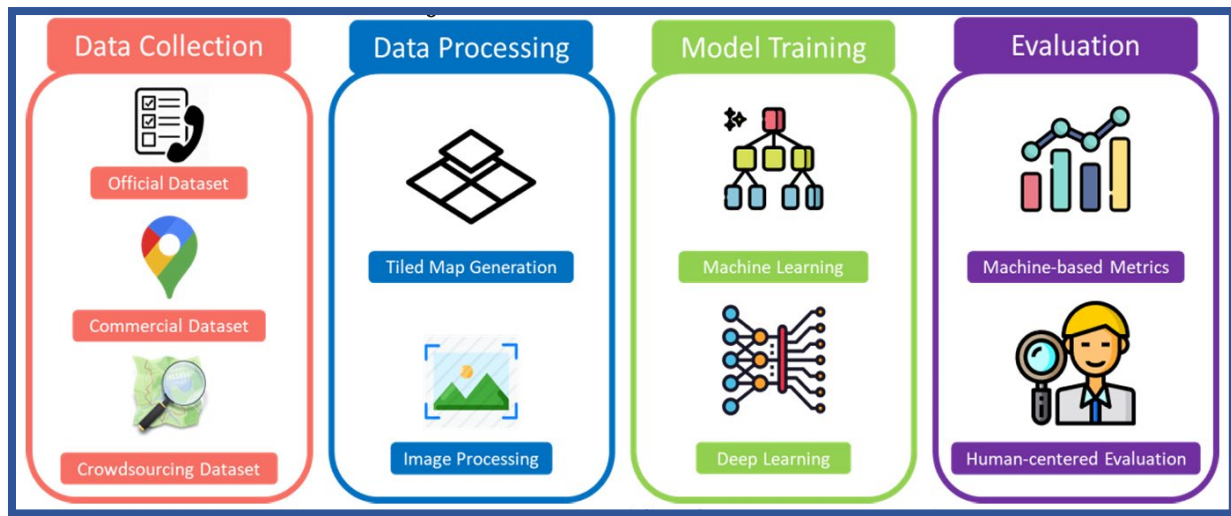
A study done by Anastasia Amponsah , Philia Latue, and Heinrich Rakuasa states in their conclusion that “The merging of artificial intelligence (AI) technology with geospatial data has opened the door to a wide range of applications that can change the way we approach health issues. In the context of health, GeoAI provides the ability for more accurate disease monitoring, analysis of health risk factors, more efficient management of health resources, and a better understanding of environmental health. The importance of mapping the spread of disease using GeoAI becomes very clear. The ability to track and understand spatial and temporal patterns of disease spread is an invaluable tool in responding to infectious disease outbreaks and taking better preventive measures. GeoAI also enables prediction of potential future disease spread, allowing authorities to plan and allocate resources more efficiently. ”

8. MAPPING AND CARTOGRAPHY

In computer cartography and graphics most insiders exchange new information by direct correspondence or through one of the annual conferences, such as the Harvard Computer Graphics Week or the International Symposium on Computer Assisted Cartography (Auto-Carto). The conferences and their proceedings indicate considerable interaction among specialists involved in computer cartography, computer graphics, digital remote sensing, and geographic information systems. Spatial Downloaded by [AAG] at 07:23 21 August 2012 statistics are used in examining satellite data and in mapping spatial data, but little attention has been given to the integration of quantitative spatial modelling with the components listed above. More important, there has been no overview addressing the larger concerns of integrating these components and more traditional techniques into an analytical whole. (Jerome E. Dobson, 1983) Recent research demonstrates great potential for implementing AI techniques, especially deep learning for cartographic design and map style transferring (see Xu and Zhao 2018; Kang, et al. 2019; Huang, et al. 2019), detection and extraction of map features, symbols, and texts (Li and Hsu 2020; Duan, et al. 2018; Duan, et al. 2020; Xie, et al. 2020; Yan, et al. 2020), and cartographic generalization (Touya, et al. 2019; Feng, et al. 2019). These directions for the use of AI in cartography are outlined as follows. First, the use of generative adversarial networks (GAN) can be extended to other mapping contexts, such as helping cartographers deconstruct the most salient stylistic elements that constitute the unique look and feel of existing designs and using this information to improve cartographic designs. Second, the topology of geographic features needs to be well retained and the map symbols and texts may require separate pattern recognition models from styling to get better outcomes. Finally, integration of AI with cartographic design may fully or partially automate the map generalization process (song gao ,2021).

We first propose a general computational framework that abstracts the workflows of integrating GeoAI into cartography. Such a framework contains four steps as show in below image.(fig:2)

FIG 2: A computational workflow for GeoAI in cartography (Auto Carto)



- i. Map data can be downloaded and generated from diverse cartographic data sources
- ii. Vector and raster map data can be processed, converted, and formatted, and cartographic knowledge might be encoded and extracted to suit the input requirements of machine learning and deep learning approaches
- iii. Diverse machine learning and deep learning models are applied for training and learning cartographic representation and knowledge; and
- iv. Evaluation approaches to measure and judge the results to examine whether results of models are robust and solid including such as objective Machine-based metrics and subjective human-centered evaluation. Figure 2 A computational workflow for GeoAI in cartography.

SOURCES: A Review and Synthesis of Recent GeoAI Research for Cartography: Methods, Applications, and Ethics BY ; Yuhao Kanga, Song Gaoa, and Robert Rotha ([Auto Carto](#))

9. URBAN PLANNING

Geospatial artificial intelligence (GeoAI) is an interdisciplinary field related to a wide range of disciplines, such as geography, GIScience, computer science, data science, remote sensing, Earth system science, urban planning, civil engineering, and public health. With the potential to advance solutions to societal challenges, GeoAI research has received tremendous attention from both academia and industry (Hu, Li, et al. 2019; W. Li 2020; Gao 2021; Chiappinelli 2022).

Geospatial data are vast spreading in many science and application domains such as smart cities, transportation, business, public health, public safety, resilience to natural disasters, climate change, etc. By processing these issues, the overall goal is to improve the quality of life for the growing urban population worldwide. Various disciplines are involved in shaping these interdisciplinary fields, including computer science, geography, Geo graphic Information Science (GIS), as well as urban studies. (A. I. Alastal et al , 2022).

10. DISASTER MANAGEMENT

GeoAI is an emerging spatial analytical framework for data-intensive geographic information science that combines innovations in geospatial technology and methods in AI and big data. While using location data from more than 4500 active satellites and billions of sensors as an input; GeoAI is able to bridge the gap between numerous disciplines in the sciences, including geography, geosciences, computer science, and engineering, to solve practical problems (Gevaert, 2022). Geospatial Artificial intelligence (GeoAI), is playing an increasingly important role in disaster risk reduction (DRR) – from the forecasting of extreme events and the development of hazard maps to the detection of events in real-time, the provision of situational awareness and decision support, and beyond. (ESCAP)

APPLICATIONS OF GEOAI IN DISASTER MANAGEMENT

- Wet weather optimization using AI

This helps to monitor the utility network and optimize capacity during wet weather events, to reduce flooding and overflows.

- Flood forecasting with limited water level data

The Fujitsu system is able to overcome this bottleneck and can predict water levels at any given time, with the additional ability to forecast for several hours. 2. Flood forecasting with limited water level data Fujitsu, under its Human Centric AI Zinrai, has developed an AI-powered flood forecasting system.

- Flood forecasting in India

Google, through its Google Public Alerts program in India, is using AI to issue flood alerts.

- Rapid Hurricane Assessment:-

NASA and Development Seed have developed a deep learning-based hurricane intensity estimator. The system uses satellite imagery as its training data to deliver live hurricane speeds.

- Simulation system for assessing industry damage of flood :-

The University of Tokyo has developed a simulation system for assessing the damage to industrial supply chains after a large-scale urban flood. This simulation system is based on multi-agent deep reinforcement learning and helps companies to develop and optimize action plans to be executed during the recovery process.

- UNOSAT Flood AI:-

The model is based on a fully convolutional neural network that takes SAR imagery as input and returns a semantic segmentation flood mask. Combining a deep learning model embedded within an automation pipeline allows for the processing of a large amount of satellite data in near-real time. UNOSAT FloodAI is also able to produce dynamic flood updates and generate automatic statistics regarding the exposed population.

- ClimateNet:-

ClimateNet is an open, community-sourced human-expert-labelled curated dataset that captures tropical cyclones (TCs) and atmospheric rivers (ARs) in high-resolution climate model output from a simulation of a recent historical period.

- Improved storm surge and flood predictions :-

The Louisiana State University developed tool to predict storm surge and flooding during severe weather events—the Coastal Emergency Risks Assessment, or CERA, website—has become an essential resource for thousands of emergency managers and first responders in Louisiana and the nation's coastal states to help protect people and infrastructure.

- Predicting physics of future fault slip in laboratory earthquakes :-

Applying machine learning to data from laboratory shear experiments at Los Alamos National Laboratory has demonstrated that continuous seismic or acoustic emission (AE) signals emanating from an active fault contain rich information regarding the instantaneous and failure timing of that system.

- Climate Alpha – measuring climate change impact :-

A new tech platform, Climate Alpha, uses a “scenario forecaster” to help answer that question— and to help predict where it might make sense to invest instead. The platform combines modern property market data with climate modelling to create foresight which is also helping cities adapt and invest in infrastructure to protect against climate impacts.

- Avalanche danger predictor

The researchers at WSL Institute for Snow and Avalanche Research have developed an avalanche warning service using computer-generated avalanche danger assessments produced by artificial intelligence on the basis of measured and weather data in its operations since last winter (2021/22).

- WRF-Fire

A new technique developed by the National Centre for Atmospheric Research (NCAR) uses artificial intelligence to efficiently update the vegetation maps that are relied on by wildfire computer models to accurately predict fire behaviour and spread.

- Sentimental Wildfires

Data scientists from Imperial's Data Science Institute used machine learning in a wildfire prediction model. In this new model, they combined social media data and geophysical satellite data to predict wildfire characteristics with high accuracy.

- Monitoring earthquakes at the speed of light

Using 350,000 modelling scenarios of earthquakes initiating at 1,400 potential earthquake locations in Japan, researchers at the Université Côte d'Azur in France succeed in instantaneously estimating the magnitude of large earthquakes based on prompt elastogravity signals (PEGS); which propagates at the speed of light, carrying earthquake information much faster than seismic waves traditionally used in early-warning systems.

- Earthquake Impact Prediction

Researchers from Hiroshima University have developed a novel artificial intelligence (AI)-based technique for estimating site amplification factors from data on ambient vibrations or microtremors of the ground. The proposed method would contribute to more accurate and more detailed seismic ground motion predictions for future earthquakes.

- Deep Learning Weather Prediction (DLWP)

Researchers from the University of Washington have improved sub-seasonal to seasonal forecasting using a novel approach to weather prediction. Using a convolutional neural network, the authors developed a machine-learning weather prediction system called Deep Learning Weather Prediction (DLWP). The model is trained on past weather data, which differs from standard numerical weather prediction models that create mathematical representations of physical laws. DLWP projects 2–6 weeks into the future for the entire globe.

- Improving Tsunami Prediction

Tsunamis often occur after vertical earthquakes, where tectonic plates on the earth's surface move mainly up and down rather than horizontally. This motion causes the displacement of a large amount of water, creating very long waves that can cause widespread damage onshore. Using this information, researchers from Cardiff University's School of Mathematics have trained AI algorithms to recognize when a vertical earthquake has occurred. These methods will complement existing technology for real-time tsunami analysis and provide another tool for experts working to detect them.

- Deepshake

Developed by researchers at Stanford University, Deepshake is a deep spatiotemporal neural network trained on more than 36,000 earthquakes and offers a new way of quickly predicting ground shaking intensity once an earthquake is underway. DeepShake improves on earthquake early warnings by making its shaking estimates directly from ground motion observations, cutting out some of the intermediate steps used by more traditional warning systems.

- Global Water Watch

To simulate access to water information for DRR, the Dutch research institute Deltares, with its partners World Resources Institute (WRI) and World Wide Fund (WWF), are developing an app which will contain worldwide, high-resolution, near-real-time, water data. Global Water Watch will provide public information about available freshwater resources. The platform will make extensive use of AI algorithms to convert earth observation data into relevant water information by merging those data with available local measurements.

(Note: the applications of GeoAI in disaster management is taken from the source [ESCAP](#))

11. POTENTIAL OF GEOAI

GeoAI, the intersection of geographic records systems (GIS) and artificial intelligence, has widespread ability in schooling. It enhances studying reviews by way of combining spatial statistics with AI-powered analytics to higher apprehend complex phenomena. GeoAI can enhance course curricula, have interaction college students via interactive maps, and offer personalized mastering tracks. Additionally, it permits instructors to evaluate pupil performance and development more effectively. Furthermore, GeoAI can be carried out in fields like urban planning, environmental technology, and disaster response, imparting real-international scenarios for students to explore and examine from it. Geospatial artificial intelligence (GeoAI) is an interdisciplinary field related to a wide range of disciplines, such as geography, GIScience, computer science, data science, remote sensing, Earth system science, urban planning, civil engineering, and public health. With the potential to advance solutions to societal challenges, GeoAI research has received tremendous attention from both academia and industry (Hu, Li, et al. 2019; W. Li 2020; Gao 2021; Chiappinelli 2022).

The integration of Artificial Intelligence in geography learning has the potential to help address complex global challenges (Latue et al., 2023). For example, AI can be used to map the spread of diseases, forecast sea level rise due to climate change, and analyse the impact of urbanization on the environment (Latue & Rakuasa, 2023). The geography is an interdisciplinary subject in which each and every sector and its sections plays an important role to develop the human society and its surrounding to maintain the environmental balance and to complete the sustainable development goals (SDG). All the subjects and their applications have geographic impact on environment and human population, it can be classified on the basis of purpose and how it will affect the environment all living beings. As the students are getting interested in the GeoAI, the findings says so that there will be huge and dynamic change will take place in future and create a scope of opportunity for government and private institution with employment. The work of image analysis, satellite image capturing, data analysis, weather forecasting, infrastructure appromovement, Disaster Risk Reduction (DRR), Detecting epidemiology and all other civil works and their observation would necessarily done by the artificial intelligence which will make a focus on environment and SDG aiming on development of human population.

12. LIMITATIONS OF GEOAI

The subject GeoAI is a very dynamic and a subject of Deep Learning and Machine Learning. there are significant challenges. First, limited access to technology is a concern (Huang et al., 2021). Not all schools or regions have adequate infrastructure to integrate Artificial Intelligence in Geography learning (Zawacki-Richter et al., 2019). This inequality of access can deepen the educational gap between different groups of students (Huang et al., 2021). The next challenge is concerns related to privacy and security of student data (Knox, 2020). The use of AI technology in monitoring student learning progress may involve the collection of sensitive personal data (Zawacki-Richter et al., 2019). Strict regulations and policies are needed to ensure that student data is not misused and their privacy is maintained (Alam, 2022). In addition, there are challenges related to curriculum and the development of learning materials that are compatible with AI technologies (Huang et al., 2021). Educators need to be trained and empowered to utilize these technologies effectively. Developing engaging and relevant learning content also requires sufficient time and resources (Zhai et al., 2021).

The Limitation of GeoAI is that it requires a well-developed focus group and mainly the teacher must have knowledge about its Potential use and Expansion. The scholars must have a focus group for spreading its awareness and information about it in the population including rural areas. The limitation of this subject is that it must get an attention from other subjects to make get interdisciplinary nature, the interdisciplinary nature depends on its application which can be clearly seen in GeoAI.

AI technology will become a partner in the learning process, helping to understand geographic patterns and forecast future trends. More than that, students will receive an in-depth education on the impact of human interaction with the environment and how technology can help address global challenges such as climate change, inequality and urbanization (Lambert et al., 2015).

SOME OF THE OBSTACLES IN LEARNING GEOAI ARE LISTED BELOW :

- Rising hardware costs

As result geospatial data keeps growing constantly, there will be an increased necessity for high-performance computing to process it. This will escalate the hardware costs to manage such a system.

- Ethical violation

There are issues related to the concerns of violation ethical values with regard to the collection of high-resolution geospatial data.

- Lack of experts

There are insufficient experts in the field of GeoAI, as it is an emerging technology. At the same time, it does not only require technology knowledge but one should have analytical and interpretive skills too [Katal, A., et al 2013].

- Data quality

It is critical to confidence in decision making. As data are more unstructured and collected from a wider array of sources, the quality of data tends to decline. A data quality control process needs to be established to delve op quality metrics, evaluate data quality, repair erroneous data, and assess a trade-off between quality assurance costs and gains [Lee, I. (2017)].

- Data errors

The source of the data should be understood to minimize the errors caused while using multiple datasets. The properties and limits of the dataset should be understood before analysis to avoid or explain the bias in the interpretation of data [Boyd, D].

- Data Cleaning

is a process of eliminating incomplete, inaccurate and redundant data from the input geospatial data source. It should be the first step of any geospatial big data project. Generally, datasets contain a high level of redundancy which should be eliminated to reduce the overall cost of the project [Min, C. et al 2014].

- Life-cycle of geospatial data

Most application scenarios in GeoAI systems require the real-time performance of big geospatial data analytics. There is a need to define the life cycle of the data, the value it can provide and the computing process to make the analytics process real-time, thus, increasing the value of the analysis [Min, C. et al 2014].

- Security and privacy

GeoAI systems and applications require high security and privacy since the data will move over various types of networks. Confidential data and information are also stored in databases. So that the high level of security and privacy of unauthorized access is the bigger issue in smart city applications [Mohbey, K.K. (2017)].

- Geospatial data analytics system

Traditional RDBMS are suitable only for structured data and they lack scalability and expandability. Though geospatial (non-relational) databases are used for processing unstructured data, there exist problems with their performances. There is a need to design a system that combines the benefits of both relational and non-relational database systems to ensure flexibility [Min, C. et al 2014 ; Li, H et al., 2014].

- Geospatial data visualization

Visualization helps in decision analysis at each and every step of the data analysis. Visualization issues are still part of data warehousing and Online Analytics Processing (OLAP) research. There is a scope for visualization tools for high-dimensional data [Min, C. et al 2014].

(**Source** : Abdelkhalek I. Alastal, Ashraf Hassan Shaqfa ., [Kuwait, Study Case](#))

13. SOLUTIONS TO DEVELOP GEOAI

The integration of AI in geography learning prepares the younger generation to contribute to solving global problems by applying geographic technology and knowledge (Huang et al., 2021). Investment in technology infrastructure, training for educators, and regulations that protect student privacy are needed. Overall, the integration of Artificial Intelligence in Geography learning offers exciting opportunities to improve the quality of education and prepare students for an increasingly complex world (Cope et al., 2021). Teacher training and building trust in AI are also determining factors. Teachers play a central role in teaching, and efforts to ensure that they are comfortable and competent in integrating AI are crucial. (H. Rakuasa et al., 2023)

Future of Geography Learning with Artificial Intelligence

- 1) Teacher Training: Provide comprehensive training to teachers on the use of AI technologies in geography learning. Teachers need to understand the potential and limitations of these technologies and how to integrate them into teaching effectively.
- 2) Learning Material Development: Design learning materials that are responsive to AI technologies. Materials should be adaptable by AI to personalize learning according to individual student needs.
- 3) Technology Infrastructure: Ensuring equitable access to AI technologies across schools and regions. This involves investing in technology infrastructure, such as adequate hardware and internet connectivity.
- 4) Evaluation and Feedback: Using AI data and analytics to monitor student learning progress. The resulting feedback can help teachers design appropriate interventions for students who need additional support.

(**SOURCE** : Integration of Artificial Intelligence in Geography Learning: Challenges and Opportunities , [Henrich Rakuasa et al ., 2023](#))

14. CONCLUSION

The research aims to discuss all the discussion on the subject i.e., GeoAI. Including its all definition , its application , potential, limitation, and unlocking its use in real word facing all the problems with studies of different geographers ,

scholars and conference statement . the term GeoAI has a great potential to solve modern day problems and to reduce loss to human population and environment . The study focuses on the practical application of GeoAI in various fields like civil works, disaster management, health sector , environment epidemiology , education field and developing the human awareness regarding the subject . The geospatial artificial intelligence has a dynamic nature and a vigorous background in the history which can be seen from 1960s. The integration of artificial intelligence in geographic Education boosts the learning interests of students and make a scope of employment with the technical field and administration works for data analysis. The study shows how can artificial can be integrated in geography , how it can solve errors in human works , the work of monitoring and much more.

CONFLICT OF INTERESTS

None.

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None.

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