Chapter 5
AI–Enabled Spatial Intelligence:
Revolutionizing Data Management and Decision Making in Geographic Information Systems

Munir Ahmad

https://orcid.org/0000-0003-4836-6151
Survey of Pakistan, Pakistan

ABSTRACT

GIS plays a crucial role in helping decision-makers to analyze and interpret complex spatial data to make informed decisions. However, conventional GIS workflows are inadequate for managing the massive amounts of spatial data that are necessary for decision-making. This chapter discussed the transformative potential of AI and spatial data in enhancing spatial intelligence. It first outlined the challenges associated with GIS, specifically related to data management and decision-making. These challenges are categorized into technical, data, and human-centered. Next, the chapter presented AI-based strategies that can be used to address these challenges, along with their potential impact. The chapter also examined the ethical considerations surrounding AI-powered GIS and suggested approaches to address them. This chapter can serve as a valuable source of information for researchers, practitioners, and policymakers operating in the realm of AI-based GIS.

INTRODUCTION

Geographical information is collected in a wide variety of formats and through various sources. Geographic Information Systems (GIS) is a software programme used in the management, analysis, and visualization of geographical data (Esri, 2023). GIS began to take shape between the 1960s and 1970s as computer technology and advancements in spatial data processing capabilities became more prevalent. The "Father of GIS," Roger Tomlinson, made significant contributions to this discipline. Tomlinson took the lead in the development of the Canada Geographic Information System during the early 1960s, which served as a cornerstone for the evolution of modern GIS. Originally, this system was created to manage and analyze resource data efficiently, specifically for rural land-use planning (Coppock & Rhind, 1991; Goodchild, 2018).

To give us a better knowledge of the world around us, GIS integrates geographic data (information about places on the surface of the earth) with other types of data (F. Wang & Luo, 2005) to acquire a better understanding of patterns and correlations that are not readily discernible in conventional numerical data. Information can be used to extend our knowledge, enhance our wisdom and reduce our uncertainty (Stillwell et al., 1999). GIS technology is a useful information system used for accurately mapping areas and locations, making it easier for people to access information about the distribution of public services and navigate their way to specific sites (Kurniadi et al., 2019). GIS system provides spatial data captured with the help of various tools and techniques for the analysis of particular situations. It has been widely used as a method for effective, efficient, and robust decision-making in the business world (Ihalauw & Tandafatu, 2021). Spatial data mining techniques are used collectively with GIS and satellite imagery in various fields (Ouchra et al., 2022). The geographic information system is designed to generate maps, manage spatial datasets, perform sophisticated "what if" spatial analyses, visualize multiple spatial datasets simultaneously, and solve location-based queries (Afgun Usmani et al., 2020). Geographic analysis in GIS facilitates the study of various processes by developing and applying suitable models (Reddy, 2018). Figure 1 illustrates a GIS model involves of five thematic layers.

GIS is used in different areas for research. GIS finds applications in multiple fields such as urban planning, environmental management, disaster response, and transportation, to name a few. It is used in the analysis of traffic monitoring, tourist monitoring, health management, and biodiversity conservation (Perumal et al., 2015). It is a highly technologically effective tool for analyzing large amounts of geographic information and making difficult decisions in the modern world (Ostroukh et al., 2020). GIS can play significant roles in both marketing planning and the decision-making process (Turk et al., 2014). The GIS-based business decision system serves for

Related Content

VLSI Implementation of a High-Speed Pipeline A/D Converter
Kiran B., Raghu N.and Manjunatha K. N. (2023). *Role of 6G Wireless Networks in AI and Blockchain-Based Applications (pp. 112-130).*
www.irma-international.org/chapter/vlsi-implementation-of-a-high-speed-pipeline-ad-converter/320328

A New Approach for Building a Scalable and Adaptive Vertical Search Engine
H. Arafat Ali, Ali I. El Desoukyand Ahmed I. Saleh (2008). *International Journal of Intelligent Information Technologies (pp. 52-79).*
www.irma-international.org/article/new-approach-building-scalable-adaptive/2430

The Strategy of Software and Application Content Industry Development in the Era of Digital Economy in Indonesia
Ahmad Budi Setiawan, Amri Dunanand Bambang Mudjiyanto (2023). *Handbook of Research on Artificial Intelligence and Knowledge Management in Asia's Digital Economy (pp. 245-270).*
www.irma-international.org/chapter/the-strategy-of-software-and-application-content-industry-development-in-the-era-of-digital-economy-in-indonesia/314796

Behavioural Intention of Customers Towards Smartwatches in an Ambient Environment Using Soft Computing: An Integrated SEM-PLS and Fuzzy Rough Set Approach
Gladys Gnana Kiruba B.and Debi Prasanna Acharjya (2020). *International Journal of Ambient Computing and Intelligence (pp. 80-111).*
www.irma-international.org/article/behavioural-intention-of-customers-towards-smartwatches-in-an-ambient-environment-using-soft-computing/250852

Fuzzy SVM With Mahalanobis Distance for Situational Awareness-Based Recognition of Public Health Emergencies
Dan Li, Zheng Qu, Chen Lyu, Luping Zhangand Wenjin Zuo (2024). *International Journal of Fuzzy System Applications (pp. 1-21).*
www.irma-international.org/article/fuzzy-svm-with-mahalanobis-distance-for-situational-awareness-based-recognition-of-public-health-emergencies/342117