

# **VISUAL DATA MINING: INTERACTIVE VISUALIZATION TECHNIQUES FOR KNOWLEDGE DISCOVERY AND DECISION SUPPORT**

**Dillep Kumar Pentyala<sup>1</sup>, Y. P.**

<sup>1</sup>Financial Analytics, JP Morgan Chase, UNITED STATES

## **ABSTRACT**

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Visual Data Mining is an interdisciplinary approach that integrates data mining algorithms with advanced visualization techniques to support effective knowledge discovery from large and complex datasets. As the volume, variety, and velocity of data continue to grow, traditional analytical methods often struggle to reveal hidden patterns and meaningful insights. Visual data mining addresses this challenge by combining the computational power of machine learning and data mining with human visual perception and interactive exploration. This approach enables users to identify trends, correlations, anomalies, and structures that may not be easily detected through automated analysis alone. The process typically involves data preprocessing, dimensionality reduction, pattern extraction, and interactive visualization, allowing analysts to iteratively refine their understanding of the data. Techniques such as scatter plots, heat maps, parallel coordinates, network graphs, and dashboard-based visual analytics play a crucial role in enhancing interpretability and user engagement. Visual data mining is widely applied across various domains, including business intelligence, healthcare analytics, bioinformatics, finance, cybersecurity, and social network analysis. By supporting intuitive exploration and hypothesis generation, it bridges the gap between raw data and actionable knowledge. Furthermore, the integration of interactive visual interfaces with data mining models improves transparency, trust, and decision-making efficiency. As data-driven systems increasingly demand explainability and user involvement, visual data mining has become a vital tool for transforming complex datasets into comprehensible and valuable insights.

**KEYWORDS:** Assessment; Information; Communication Technology; Intervention; Dyscalculia; Web-based Tools; Mobile Apps

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## **INTRODUCTION**

Seeing is knowing; however, just seeing is adequately not. At the point when you get what seeing becomes accepting. Some time back, researchers found that seeing and seeing together empower people to gather information and more profound knowledge from a lot of information. The methodology incorporates the human brain's

investigation capacities with the tremendous handling force of PCs to shape a fantastic information revelation climate that benefits from the most innovative possible solution. The innovation expands on visual, what's more, scientific cycles created in different orders counting logical perception, information mining, insights, and AI with custom augmentations that handle enormous, multidimensional, multivariate informational indexes. The technique depends on both usefulness that describes constructions and presentations information and human capacities that see designs, exemptions, patterns, furthermore, connections. Here I'll characterize the vision, present the best in class, and talk about the fate of a youthful order called visual information mining.

### **THE VISION**

The vision of a visual information mining framework originates from the accompanying standards: straightforwardness, client independence, unwavering quality, reusability, accessibility, and security.

An optical data mining framework should be linguistically straightforward to be valuable. Basic doesn't mean insignificant or nonpowerful. Easy to learn implies using natural and well-disposed input systems just as wild and simple to-decipher yield information. Easy to apply suggests a compelling talk among people and data. Essential to recover or review means a tweaked information design to work with quick and dependable inquiries. Easy to execute suggests a base number of steps expected to accomplish the outcomes. So, straightforward methods the littlest, practically adequate framework conceivable.

However, a certified visual information mining framework should not force information on its clients but instead manage them through the mining interaction to reach determinations. People ought to study the visible reflections and gain understanding rather than tolerating a mechanized choice.

A solid visual information mining framework should give assessed mistakes or precision of the projected data for each progression of the mining interaction. This blunder data can make up for the insufficiency that loose investigation of information representation can cause.

A reusable visual information mining framework should be versatile to an assortment of frameworks and conditions to lessen the customization exertion, give guaranteed execution, what's more, improve framework transportability.

A viable visual data mining framework should be, by and large furthermore, generally accessible. It might mean a convenient framework through tele-links or an installed (neighborhood) framework inside the data area. This necessitates that the information gotten starting with one space adjust then onto the next room through actual methods or electronic associations. At last, a comprehensive visual information mining

framework must incorporate safety efforts to ensure the information, the recently found information, and the client's character because of different social issues.

So far, I've overlooked examining the basic perception also, numerical strategies of visual information mining. This is somewhat a direct result of as far as possible and part of the way due to the consistent and steady innovative headways in visual information mining. You can discover tests of the most recent advancements in this uncommon issue. Albeit nobody associated with this energizing field has every one of the specialized arrangements today, everybody is completely mindful of the great difficulties ahead.

### **CURRENT STATE OF THE ART**

Representation has been utilized regularly in information mining as a showing apparatus to create beginning perspectives, explore information with complex designs, and pass on the consequences of an examination. For the most part, the insightful strategies themselves don't include perception. The freely coupled connections among perception and insightful information mining methods address the more significant part of the present best in class in visual information mining. The measure sandwich system, which joins insightful measures with realistic representation, punishes both methods with one another's lacks and limits. For instance, because an insightful cycle can't dissect interactive media information, we need to surrender the qualities of representation to consider films and music in a visual information mining climate.

Maybe a more grounded visual information mining procedure lies in firmly coupling the representations and scientific cycles into one information mining instrument and letting human perception take part in a logical interaction's dynamic stays a significant test. Certain numerical advances inside an insightful method might be subbed by human choices dependent on representation to permit the same insightful approach to break down a more extensive extent of data. Declaration upholds people in managing with options that can, at this point don't be robotized. This brings about a firmly coupled visual information mining climate that genuinely exploits the qualities of all universes.

### **THE FUTURE**

All signs show that the field of visual information mining will keep on developing at a considerably quicker speed later on. In colleges and examination labs, visual information mining will assume a significant part in physical and data sciences to investigate significantly more meaningful and more intricate logical informational indexes. Likewise, it will take a functioning part in nontechnical controls to set up information areas to look for answers and certainties. For instance, standard "man" pages may exist for our number one visual information mining capacities on our Unix framework. A high-level type of scatterplot framework may fill in for the utilization of

covariance. Furthermore, relapse in insights examines. Public norms will be created to oversee the usefulness and assets of visual information mining.

In ventures and families the nation over, visual information mining will be implanted in available utilities and home apparatuses. Many are looking through references, for example, the business catalog, word references, and even papers— will have visual mining ability. There might be PC chips devoted to helping visual information mining exercises. The term visual information mining will be incorporated in school reading material and writing. Sound or haptic-based substitutes will help the outwardly impeded. Our creative mind is the lone furthest reaches of things to come.

### **CONCLUSION**

This issue grandstands an energizing field where individuals transform seeing into knowing, accepting, and at last human bits of knowledge. I get the vision characterized here can be reached and the proposed errands achieved. As the articles in this issue show, both the freely and firmly coupled visual information mining frameworks perform well in certain areas and conditions. Researchers and designers will keep on investigating new ground and find new applications in this youthful control. Concerning what's to come, I see the headway of visual information mining looking like the fast development of PCs in our general public. The dynamic support of people and the choices because of perception consolidate the specialty of human instinct, furthermore, the study of numerical allowance, for eternity changing the scene of information examination.

### **REFERENCES**

- [1] Williams, R., Ali, S., Devasia, N., DiPaola, D., Hong, J., Kaputsos, S. P., ... & Breazeal, C. (2023). AI+ ethics curricula for middle school youth: Lessons learned from three project-based curricula. *International Journal of Artificial Intelligence in Education*, 33(2), 325-383.
- [2] Yarram, V. K., & Parimi, S. K. (2021). Design and Implementation of a Responsible, Explainable, and Compliance-Driven AI Architecture for Enterprise-Scale Content Management Systems Integrating Generative Models, Retrieval Pipelines, and Real-Time Governance Controls. *International Journal of Modern Computing*, 4(1), 96-110.
- [3] Jaladi, D. S., & Vutla, S. (2019b). Revolutionizing Healthcare Through Quantum Computing: Insights and Future Directions. *International Journal of Modern Computing*, 2(1), 60-83.
- [4] Putchakayala, R., & Yallavula, R. (2025). The Intelligent Governance Core: A Multi-Layer AI Framework for Predictive Compliance and Autonomous Digital Analytics. *International Journal of AI, BigData, Computational and Management Studies*, 6(1), 171-179.
- [5] Lurie-Luke, E. (2024). Alternative protein sources: science powered startups to fuel food innovation. *Nature Communications*, 15(1), 4425.

- [6] Putchakayala, R., & Yarram, V. K. (2025). Adaptive Trust Engineering: AI-Driven Full-Stack Mechanisms for Privacy, Compliance, and Data Quality. *The Metascience*, 3(2), 1-21.
- [7] Feng, P., Bi, Z., Wen, Y., Pan, X., Peng, B., Liu, M., ... & Jiang, Z. (2024). Deep Learning and Machine Learning, Advancing Big Data Analytics and Management: Unveiling AI's Potential Through Tools, Techniques, and Applications. *arXiv preprint arXiv:2410.01268*.
- [8] Cherukuri, R., & Parimi, S. K. (2025). AI-Enabled Architecture for Large-Scale Multi-Tenant Systems. *International Journal of Modern Computing*, 8(1), 1-10.
- [9] Jaladi, D. S., & Vutla, S. (2017). Harnessing the Potential of Artificial Intelligence and Big Data in Healthcare. *The Computertech*, 31-39.
- [10] Cherukuri, R., & Putchakayala, R. (2021). Frontend-Driven Metadata Governance: A Full-Stack Architecture for High-Quality Analytics and Privacy Assurance. *International Journal of Emerging Research in Engineering and Technology*, 2(3), 95-108.
- [11] Gudepu, B. K., & Jaladi, D. S. (2018a). The Role of Data Profiling in Improving Data Quality. *The Computertech*, 21-26.
- [12] Putchakayala, R., & Cherukuri, R. (2022). AI-Enabled Policy-Driven Web Governance: A Full-Stack Java Framework for Privacy-Preserving Digital Ecosystems. *International Journal of Artificial Intelligence, Data Science, and Machine Learning*, 3(1), 114-123.
- [13] Cohen, M. (2022). *Rethinking Thinking: Problem Solving from Sun Tzu to Google*. Andrews UK Limited.
- [14] Putchakayala, R., & Cherukuri, R. (2024). AI-Enhanced Event Tracking: A Collaborative Full-Stack Model for Tag Intelligence and Real-Time Data Validation. *International Journal of Artificial Intelligence, Data Science, and Machine Learning*, 5(2), 130-143.
- [15] Cherukuri, R., & Putchakayala, R. (2022). Cognitive Governance for Web-Scale Systems: Hybrid AI Models for Privacy, Integrity, and Transparency in Full-Stack Applications. *International Journal of AI, BigData, Computational and Management Studies*, 3(4), 93-105.
- [16] Jaladi, D. S., & Vutla, S. (2018a). An Analysis of Big Data Analytics in Relation to Artificial Intelligence and Business Intelligence. *The Computertech*, 37-46.
- [17] Cherukuri, R., & Yarram, V. K. (2023). AI-Orchestrated Frontend Systems: Neural Rendering and LLM-Augmented Engineering for Adaptive, High-Performance Web Applications. *International Journal of Emerging Research in Engineering and Technology*, 4(3), 107-114.
- [18] Jaladi, D. S., & Vutla, S. (2018b). The Use of AI and Big Data in Health Care. *The Computertech*, 45-53.
- [19] Cherukuri, R., & Yarram, V. K. (2024). From Intelligent Automation to Agentic AI: Engineering the Next Generation of Enterprise Systems. *International Journal of Emerging Research in Engineering and Technology*, 5(4), 142-152.
- [20] Gudepu, B. K., & Jaladi, D. S. (2018b). The Role of Data Quality Scorecards in Measuring Business Success. *The Computertech*, 29-36.

- [21] Parimi, S. K., & Cherukuri, R. (2024). Proactive AI Systems: Engineering Intelligent Platforms that Sense, Predict, and Act. *International Journal of Emerging Trends in Computer Science and Information Technology*, 5(3), 122-130.
- [22] Yallavula, R., & Parimi, S. K. (2022). Bridging Data, Intelligence, and Trust the Future of Computational Systems and Ethical AI. *International Journal of Modern Computing*, 5(1), 119-129.
- [23] Jaladi, D. S., & Vutla, S. (2020a). Leveraging Data Mining to Innovate Agricultural Applications. *International Journal of Modern Computing*, 3(1), 34-46.
- [24] Parimi, S. K., & Yallavula, R. (2021). Data-Governed Autonomous Decisioning: AI Models for Real-Time Optimization of Enterprise Financial Journeys. *International Journal of Emerging Trends in Computer Science and Information Technology*, 2(1), 89-102.
- [25] Jaladi, D. S., & Vutla, S. (2024b). The Role of Artificial Intelligence in Modern Medicine. *The Metascience*, 2(4), 96-106.
- [26] Parimi, S. K., & Yallavula, R. (2023). Enterprise Risk Intelligence: Machine Learning Models for Predicting Compliance, Fraud, and Operational Failures. *International Journal of Emerging Trends in Computer Science and Information Technology*, 4(2), 173-181.
- [27] Xiong, Z., Liang, Z., Liu, X., Feldmann, M., & Li, J. (2023). Steel-UHPC composite dowels' pull-out performance studies using machine learning algorithms. *Steel and Composite Structures*, 48(5), 531-545.
- [28] Parimi, S. K., & Yallavula, R. (2025). Generative AI for Enterprise Trust: A Governance-Aligned Framework for Safe and Transparent Automation at Global Scale. *International Journal of Artificial Intelligence, Data Science, and Machine Learning*, 6(1), 218-225.
- [29] Himeur, Y., Varlamis, I., Kheddar, H., Amira, A., Atalla, S., Singh, Y., ... & Mansoor, W. (2023). Federated learning for computer vision. *arXiv preprint arXiv:2308.13558*.
- [30] Yarram, V. K., & Parimi, S. K. (2024). The Next Frontier of Enterprise Transformation: A Comprehensive Analysis of Generative AI as a Catalyst for Organizational Modernization, Intelligent Automation, and Large-Scale Knowledge Acceleration Across Global Digital Ecosystems. *The Metascience*, 2(2), 97-106.
- [31] Jaladi, D. S., & Vutla, S. (2024a). Machine Learning Techniques for Analyzing Large-Scale Patient Databases. *International Journal of Modern Computing*, 7(1), 181-198.
- [32] Yallavula, R., & Putchakayala, R. (2022). A Data Governance and Analytics-Enhanced Approach to Mitigating Cyber Threats in NoSQL Database Systems. *International Journal of Emerging Trends in Computer Science and Information Technology*, 3(3), 90-100.
- [33] Jaladi, D. S., & Vutla, S. (2020b). Machine Learning Demystified: Concepts, Algorithms, and Use Cases. *The Computertech*, 1-12.
- [34] Yallavula, R., & Putchakayala, R. (2024). AI for Data Governance Analysts: A Practical Framework for Transforming Manual Controls into Automated Governance Pipelines. *International Journal of AI, BigData, Computational and Management Studies*, 5(1), 167-177.
- [35] Jaladi, D. S., & Vutla, S. (2021b). Quantum AI: Accomplishments and Obstacles in the Convergence of Quantum Computing and Artificial Intelligence. *International Journal of Modern Computing*, 4(1), 86-95.

- [36] Yallavula, R., & Yarram, V. K. (2021). An AI Framework for Monitoring Rule Changes in Highly Volatile Compliance Environments. *The Computertech*, 39-53.
- [37] Gudepu, B. K., & Jaladi, D. S. (2022b). Why Real-Time Data Discovery is a Game Changer for Enterprises. *International Journal of Acta Informatica*, 1(1), 164-175.
- [38] Jaladi, D. S., & Vutla, S. (2022a). Artificial Intelligence's Influence on Design: A New Era of Creative Collaboration. *International Journal of Acta Informatica*, 1(1), 188-198.
- [39] Yarram, V. K., & Cherukuri, R. (2023). From Data to Decisions: Architecting High-Performance AI Platforms for Fortune 500 Ecosystems. *The Metascience*, 1(1), 306-324.
- [40] Wu, X., Jiang, L., Wang, P. S., Liu, Z., Liu, X., Qiao, Y., ... & Zhao, H. (2024). Point transformer v3: Simpler faster stronger. In *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition* (pp. 4840-4851).
- [41] Yallavula, R., & Putchakayala, R. (2023). Governance-of-Things (GoT): A Next-Generation Framework for Ethical, Intelligent, and Autonomous Web Data Acquisition. *International Journal of Artificial Intelligence, Data Science, and Machine Learning*, 4(4), 111-120.
- [42] Gudepu, B. K., Jaladi, D. S., & Gellago, O. (2023). How Data Catalogs are Transforming Enterprise Data Governance: A Systematic Literature Review. *The Metascience*, 1(1), 249-264.
- [43] Yarram, V. K., & Yallavula, R. (2022). Adaptive Machine Learning Driven Compliance Scoring Models for Automated Risk Detection, Quality Validation of AI-Generated Content in Regulated Industries. *International Journal of Emerging Research in Engineering and Technology*, 3(1), 116-126.
- [44] Parimi, S. K., & Yarram, V. K. (2022). AI-First Enterprise Architecture: Designing Intelligent Systems for a Global Scale. *The Computertech*, 1-18.
- [45] Koç, B., & Çetintaş, D. (2024). Diagnosis Enhancement Using Deep Learning: YOLOv11-YOLOv8 for Alzheimer's and Parkinson's Disease Detection. *UAKK 2024*, 13.
- [46] Kshetri, N., Hughes, L., Louise Slade, E., Jeyaraj, A., Kumar Kar, A., Koohang, A., ... & Wright, R. (2023). "So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. *International Journal of Information Management*, 71, 102642.
- [47] Putchakayala, R., & Parimi, S. K. (2023). AI-Optimized Full-Stack Governance A Unified Model for Secure Data Flows and Real-Time Intelligence. *International Journal of Modern Computing*, 6(1), 104-112.
- [48] Jaladi, D. S., & Vutla, S. (2019a). Deploying Breiman's Random Forest Algorithm in Machine Learning. *The Computertech*, 45-57
- [49] Putchakayala, R., & Yallavula, R. (2024). AI-Driven Federated Data Governance: Building Trustworthy and Sustainable Digital Ecosystems. *International Journal of Modern Computing*, 7(1), 219-227.
- [50] Yarram, V. K., & Cherukuri, R. (2025). User Experience Patterns for Front-End Integration of Retrieval-Augmented Generation in Enterprise Platforms. *International Journal of Emerging Trends in Computer Science and Information Technology*, 6(2), 87-94.