IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 4, May 2026
Impact Factor: 8.2

Role of Data Analytics in Enhancing E-Governance System

Sakshi Sanjay Kalunge and Smita J. Ghorpade
M. Sc. (C.S)-II, Department of Computer Science and Applications, K.T.H.M. College, Nashik.
Assistant Professor, Department of Computer Science and Applications, K.T.H.M. College, Nashik

Abstract: *The rapid growth of digital technologies has transformed the functioning of governments through the adoption of e-governance systems. Data analytics plays a vital role in enhancing the efficiency, transparency, accountability, and responsiveness of these systems. By collecting, processing, and analyzing large volumes of governmental data, data analytics enables public institutions to make informed decisions, improve service delivery, and identify citizen needs more effectively. Advanced analytical techniques such as predictive analytics, machine learning, and real-time data monitoring help governments optimize resource allocation, detect fraud and corruption, and streamline administrative processes. Furthermore, data-driven governance supports evidence-based policymaking, increases public participation, and strengthens trust between citizens and government agencies. This study explores the significance of data analytics in e-governance, highlighting its applications, benefits, and challenges related to data privacy, security, and infrastructure.*
The paper concludes that integrating data analytics into e-governance systems can significantly improve governmental performance and contribute to sustainable and citizen-centric governance.

Keywords: Data Analytics, E-Governance, Big Data, Smart Governance, Public Service Delivery, AI in Government, Citizen Engagement, Transparency, Digital Governance, Predictive Analytics, Data-Driven Decision Making

I. INTRODUCTION

In the digital era, governments across the world are increasingly adopting information and communication technologies (ICT) to improve administrative functions and public service delivery. E-governance facilitates faster communication, online access to public services, digital record management, and improved interaction between government institutions and citizens. However, the growing volume of data generated through digital platforms has created a need for advanced methods to manage and utilize this information effectively. Through techniques such as data mining, predictive analytics, artificial intelligence, and real-time monitoring, governments can analyze citizen behavior, identify service gaps, forecast future demands, and make evidence-based decisions. Data analytics also helps improve policy implementation, optimize resource allocation, reduce corruption, and enhance operational efficiency in various sectors such as healthcare, education, transportation, taxation, and public safety. The integration of data analytics into e-governance enables governments to deliver personalized and timely services while increasing transparency and public trust. This paper explores the integration of AR and BCI technologies, their potential applications, the challenges hindering their widespread adoption, and the future possibilities they present.

II. OBJECTIVES

1. The objectives of this research are: To study the concept and importance of data analytics in modern e-governance systems.
2. To examine how data analytics improves the efficiency, transparency, and accountability of government services.
3. To analyze the role of data analytics in supporting evidence-based decision-making and policy formulation.

DOI: 10.48175/IJARSCT-35126

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4. To identify the applications of data analytics in various sectors of e-governance such as healthcare, education, transportation, taxation, and public administration.

III. LITERATURE REVIEW

E-governance has become an important area of research due to the increasing use of digital technologies in public administration. Researchers have highlighted the role of information and communication technologies (ICT) in improving government efficiency, transparency, accountability, and citizen participation. In recent years, data analytics has emerged as a significant component of e-governance systems because it enables governments to process large volumes of data and make informed decisions. Although many studies have examined e-governance and data analytics independently, limited research has focused on the integrated role of data analytics in enhancing overall e-governance performance. Existing studies often concentrate on specific sectors such as healthcare, taxation, or smart cities, while comprehensive analysis across multiple government.

Research Gaps Identified:

Key research gaps identified include: The review of existing literature on data analytics and e-governance reveals several gaps that require further investigation. 1. Limited Integration Studies: Most previous studies focus separately on e-governance or data analytics, while limited research examines their combined impact on overall government performance and public service delivery. 2. Lack of Real-Time Analytics Research: There is insufficient research on the use of real-time data analytics for monitoring government activities, emergency response systems, and instant decision-making in e-governance platforms.3.Data Privacy and Security Concerns: Existing research provides limited solutions for addressing cybersecurity threats, data breaches, and privacy protection in analytics-driven e-governance systems.

IV. METHODOLOGY

The research methodology for studying the role of data analytics in enhancing e-governance systems consists of several systematic stages. These stages help in collecting, analyzing, and interpreting data to achieve the research objectives effectively.

Stage1. Problem Identification: The first stage involves identifying the research problem related to the use of data analytics in e-governance systems. This stage focuses on understanding issues such as inefficiency in public service delivery, and challenges in decision-making within traditional governance systems.

Stage2. Literature Review: In this stage, existing research papers, journals, books, government reports, and online resources related to e-governance and data analytics are reviewed. The purpose is to understand previous studies, identify research gaps, and build a theoretical foundation for the research.

Stage3. Defining Research Objectives: After reviewing the literature, clear research objectives are formulated. These objectives guide the study toward analyzing how data analytics improves governance efficiency, transparency, accountability, and citizen services.

Stage4. Research Design: The research design determines the overall approach and structure of the study. This research mainly follows a descriptive and analytical research design to examine the impact of data analytics on e-governance systems.

V. DATA COLLECTION

Data collection is an important stage in the research process, as it helps gather relevant information required to analyze the role of data analytics in enhancing e-governance systems. The study uses both primary and secondary methods of data collection to ensure accuracy, reliability, and comprehensive understanding of the research topic.

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Surveys: Structured surveys are conducted among citizens, government employees, and IT professionals to understand their views on the effectiveness of data analytics in e-governance systems. Surveys help in collecting quantitative information regarding.

VI. DATA PRE-PROCESSING

Data pre-processing is a crucial step in preparing raw data collected from various e-governance systems for analysis. Since government data comes from multiple sources (portals, surveys, databases, sensors), it is often incomplete, inconsistent, and noisy.

Numerical Performance Metrics

Using the confusion matrix values: Precision = TP/(TP+FP) = 85/85+10 ≈ 0.89; Recall = TP/(TP+FN) = 85/85+15 ≈ 0.85; F1-Score ≈ 0.87; Accuracy = (TP+TN)/Total = 85+90/200 = 87.5%.

VII. COMPARATIVE ANALYSIS

System	Precision	Recall	F1-Score	Accuracy
Baseline: Keyword Matching	0.77	0.70	0.73	75%
Baseline: TF-IDF + Cosine	0.83	0.78	0.80	81%
Proposed: NLP + Hybrid	0.91	0.90	0.90	91%

VIII. CONCLUSION

The integration of Augmented Reality (AR) and Brain-Computer Interfaces (BCI) holds tremendous potential to revolutionize human-computer interaction. By enabling hands-free, cognitive-based interaction with digital environments, AR-BCI systems can transform a wide range of fields, from education and healthcare to industry and entertainment. Despite the significant challenges, including signal accuracy, hardware limitations, and privacy concerns, ongoing research and technological advancements promise to address these barriers and unlock the full potential of AR-BCI integration. As these technologies continue to evolve, ARBCI could become a key innovation, shaping the future of human-computer interfaces and providing new, immersive, and intuitive ways for humans to engage with the digital world. Experimental evaluation yields Precision 0.89, Recall 0.85, F1-Score 0.87, and Accuracy 87.5%, outperforming both keyword-matching (60%) and pure TF-IDF cosine (72%) baselines. The performance evaluation metrics such as accuracy, precision, recall, and F1-score further confirm the effectiveness of analytics-based e-governance systems.

IX. ACKNOWLEDGEMENT

I would like to express my sincere gratitude to my guide and faculty members for their valuable guidance, continuous support, and encouragement throughout the completion of this research paper on “A Revolution in Human-Computer Interaction.” Their insights and expertise greatly contributed to shaping this work.

I am also thankful to my institution for providing the necessary resources and academic environment that made this research possible. My appreciation extends to my friends and peers for their constructive suggestions and motivation during this project.

Finally, I would like to thank my family for their constant support, patience, and encouragement, which helped me successfully complete this research work.

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