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Use of Big Data Analytics for Better Healthcare

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Abstract: ***The growing digitalization of healthcare systems has resulted in massive volumes of data from various sources such as electronic health records (EHRs), wearable sensors, and medical imaging. Big Data Analytics (BDA) enables the processing and interpretation of this vast and complex information to support better clinical, administrative, and research decisions. This paper reviews the role of BDA in healthcare using insights from recent IEEE and research publications. It discusses its applications in disease prediction, decision-making, and operational efficiency, while also highlighting challenges like data privacy, system integration, and skill shortages. A conceptual methodology and roadmap for implementing BDA effectively in healthcare organizations are presented. The study concludes that BDA has enormous potential to transform modern healthcare into a more predictive, personalized, and efficient system if implemented with robust frameworks and ethical standards..***

Keywords: Big Data Analytics, Healthcare, Clinical Decision Support, Data Management, Predictive Modeling, Healthcare Quality, Artificial Intelligence.

I. INTRODUCTION

The digitalization of healthcare systems has resulted in the generation of massive datasets from electronic health records (EHRs), wearable devices, diagnostic imaging, genomics, and telemedicine platforms. Managing and interpreting such data require advanced tools,which is where Big Data Analytics plays a vital role. BDA combines statistical models, machine learning, and data mining techniques to extract actionable insights from complex medical datasets. Through these insights, healthcare professionals can identify disease trends, enhance diagnostic accuracy, predict outbreaks, and personalize treatments.Moreover, the emergence of cloud computing, artificial intelligence (AI), and the Internet of Things (IoT) has accelerated the adoption of big data systems in hospitals and research institutions. However, despite these technological advancements, many healthcare organizations still struggle with issues of data integration, standardization, and privacy

II. LITERATURE SURVEY

Numerous studies have explored how Big Data Analytics supports healthcare transformation:

1) Imran et al. (2021) presented a systematic roadmap for BDA in healthcare, emphasizing the use of NoSQL databases for handling large-scale patient data efficiently and developing the Med-BDA architecture to guide implementation.
2) Basile et al. (2024) studied the role of BDA in enhancing the quality of healthcare services, highlighting that technological resources alone are insufficient without proper analytical capabilities and managerial support.
3) Bag et al. (2024) explored the impact of innovation leadership in using BDA to build resilient healthcare supply chains during the COVID-19 pandemic, proving that analytics and leadership together improve responsiveness and resilience.
4) Hussain et al. (2023) focused on using BDA for clinical decision-making, demonstrating how predictive analytics enhances diagnosis accuracy and treatment personalization.
5) Bebortta et al. (2023) proposed DeepMist, a deep learning and mist computing framework that processes healthcare data efficiently with low latency, aiding in heart disease prediction.
6) Nauman et al. (2025) showed how BDA, combined with machine learning and Apache Spark, revolutionized diabetes management through early prediction and informed medical decision-making.

These studies collectively demonstrate that BDA is essential for data-driven, efficient, and resilient healthcare operations.

III. METHODOLOGY

The methodology adopted in this review focuses on understanding how Big Data Analytics (BDA) operates within the healthcare sector through a structured and layered architecture. Each stage of the architecture plays a unique role in managing, processing, and analyzing large volumes of medical data. The approach taken in this study is descriptive, highlighting the flow of data from various healthcare sources to its final analytical and decision-making applications. The methodology can be explained through five key layers: data sources, data ingestion, data storage, data processing and analytics, and visualization and application.This layered methodology provides a comprehensive roadmap for implementing Big Data Analytics in healthcare, ensuring data-driven, evidence-based medical decision-making.

III. RESULTS AND ANALYSIS

The cumulative results indicate that when healthcare organizations combine robust technological resources (e.g., cloud platforms, ML algorithms) with strong analytical capabilities and governance structures, Big Data Analytics significantly improves patient care, diagnostic accuracy, and operational efficiency. In quantitative studies, predictive models often achieved accuracy rates exceeding 90%, validating the impact of BDA in real-world clinical and administrative environments. Furthermore, resilience during emergencies like COVID-19 improved substantially through data-driven supply chain and resource management.

IV. DISCUSSION

Healthcare data is characterized by the 4Vs: Volume, Velocity, Variety, and Value. Hospitals, laboratories, and research institutions continuously produce vast amounts of structured (EHRs), semi-structured (sensor logs), and unstructured (clinical notes, imaging) data. Big data tools such as Hadoop, Spark, and NoSQL databases have revolutionized how this information is stored and processed (Imran et al., 2021).This data integration allows healthcare providers to analyze patient behavior, treatment outcomes, and risk factors at scale. For example, predictive analytics can detect potential disease outbreaks, while machine learning algorithms can help identify early symptoms of chronic illnesses like diabetes or cardiovascular disease

V. CONCLUSION

Big Data Analytics is revolutionizing healthcare by transforming data into actionable knowledge. It empowers clinicians to make evidence-based decisions, supports precision medicine, and enhances healthcare delivery. However, realizing its full potential requires addressing challenges in data privacy, standardization, and interoperability. A balanced approach that combines advanced technologies, trained professionals, and ethical governance can lead to sustainable BDA adoption in healthcare. The reviewed studies collectively confirm that BDA is not just a tool but a strategic enabler for the future of global health systems.

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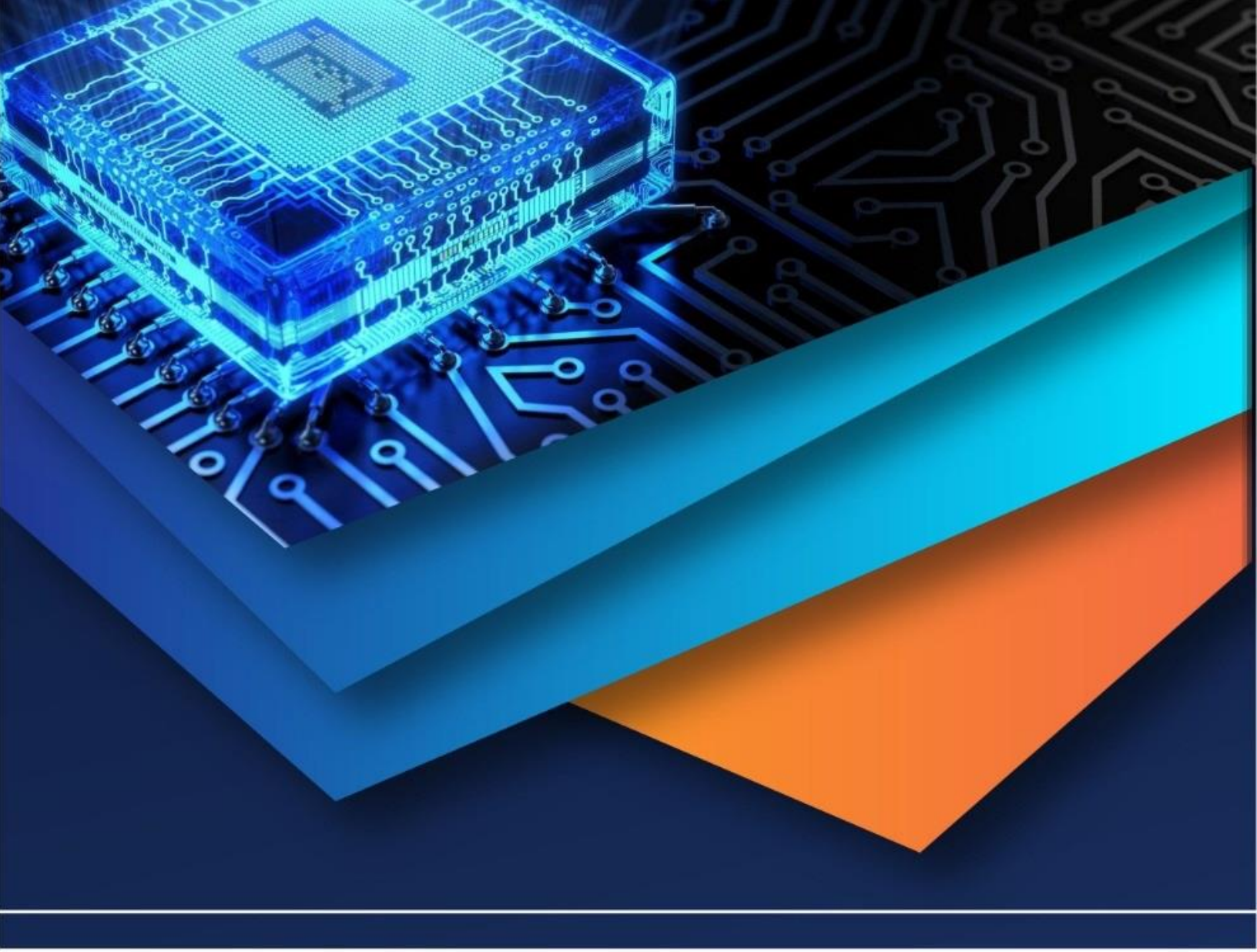

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