IJCRSSSL International Journal of Current Researches in Sciences, Social Sciences and Languages

Volume: 04 | Issue: 02 | 2024 | Open Access | Impact Factor: 5.735

Evolving Data Management: Transitioning from Relational Databases to NoSQL for Scalable Solutions

Armiya'u Nasiru Muhammad[1], Etemi Joshua Garba[2], Kamak Yamlach Shedrach[3]

[1,2,3]Faculty of Science, Department of Computer Science, Taraba State University Jalingo

Abstract: The evolution of database systems has undergone significant shifts with the emergence of Non-relational Structured Query Language (NoSQL) systems, catering to the increasing demand for scalable and efficient data management solutions. This comprehensive review explores the transition from traditional relational database management systems (RDBMS) to NoSQL databases in response to the challenges posed by big data and the need for flexible data handling. Beginning with an examination of the advantages and limitations of relational database systems, the review highlights the shortcomings in scalability and flexibility, prompting the adoption of NoSQL databases. Overall, this review offers a comprehensive overview of the evolution of database systems, providing valuable insights for researchers, practitioners, and decision-makers navigating the complexities of modern data management.

Keywords: Large Data Management, NoSQL Technology, Scalability, Data Modeling, Evolution.

INTRODUCTION

Data that has meaning becomes information and is the starting point where people often start their studies. Data is supposed to be stored properly so that it can become information for whoever is accessing it. Finally, a system came into reality that gathers all important information about services or a particular product. And then things are upgraded by people according to their needs. Manual System moved to a Data processing system. Later data processing moved to information processing, and in the end, came up with the demand for MIS (Management Information systems) Praveen et al. (2017).

NoSQL systems are becoming highly popular databases with great scale and performance in operations, making them ideally used for dealing with a large volume of data. That is to say, traditional databases that favored fine data integrity were the databases of choice in the case of data warehousing, but with the rising popularity of big data and the need to deal with large volumes of data, it has manifested that NoSQL databases ensure a flexible solution. An easy and common example of a NoSQL database is that which is brought about by stores, otherwise referred to as key-value stores. Such is very easy to design, aids a lot in the scaling time, and offers fast and effective operation for data retrieval (Jain, 2023).

Khatri (2022) added that on the other side is the SQL databases which have proven their worth for over 40 years with their matured standards and a great community that is capable of further enhancement. Innovative proposals in the architectural design of systems build on aspects whereby digital technology can aid in industrial advancement. It is not considered in general but has a big impact on the performance of IMS architecture. In many respects, databases are more of a support system for IMS performance rather than a direct component (Furlan et al., 2021).

RELATIONAL DATABASE SYSTEMS

A relational database system is a system for managing structured information that is based on the description, updating, and making of queries of a database in Structured Query Language (SQL). SQL, though, displays all of its might best when there are structured, ordered databases containing defined types of tables. So, first of all, it is necessary to reformat all information that users need to integrate with tables. This can create complexities, challenges, and time-consuming processes when dealing with data that doesn't fit well into a tabular form.

IJCRSSL
International Journal of Current Researches in Sciences, Social Sciences and Languages
Volume: 04 | Issue: 02 | 2024 | Open Access | Impact Factor: 5.735

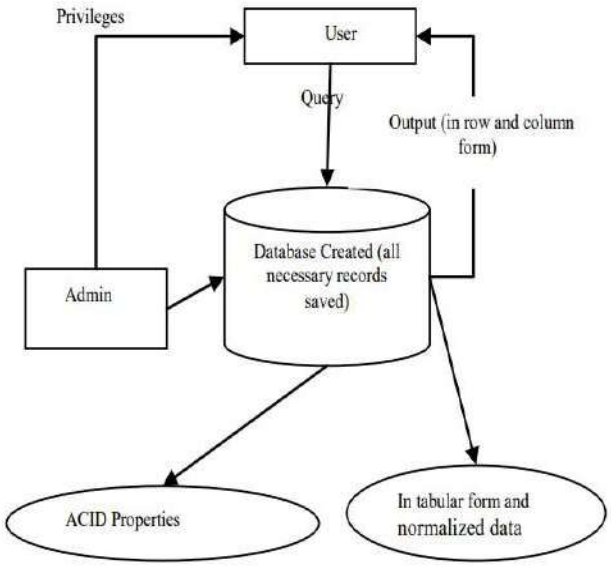

Figure 1: Relational Database Praveen et al. (2017).

ADVANTAGES OF RELATIONAL DATABASE SYSTEMS

- Maintenance of Persistent Data.
- Concurrency
- Data Integrity
- Standard Model

CHALLENGES OF RELATIONAL DATABASE SYSTEMS

Shraddha and Maddipatla, in 2015 identified the following challenges:

- Meaning and comprehensive analysis of the data is hardly extracted in a serious sense.
- The impact of the relationship between the growth rate of data volumes and the growth rate in demand to manage and process data effectively, adds to the scalability concern.
- Expensive

DISTRIBUTED SYSTEMS

In answer to the ever-increasing demand for scalable and distributed data management solutions, early Database Management Systems sought to pioneer distributed architectures that incorporated the concepts of data distribution, coherence, and consistency.

The basic architecture that formed the foundation in this regard followed the creation of distributed data through several server nodes that collectively and statistically formed up as server clusters to thereby help support better data storage and data processing capability.

Partitioning, for example, permitted databases to be fragmented into actual segments distributed along manifold computing nodes to thereby optimize resource utilization and improve data accessibility. Another mode was through replication (Kai, 2010).

IJCRSSSL International Journal of Current Researches in Sciences, Social Sciences and Languages

Volume: 04 | Issue: 02 | 2024 | Open Access | Impact Factor: 5.735

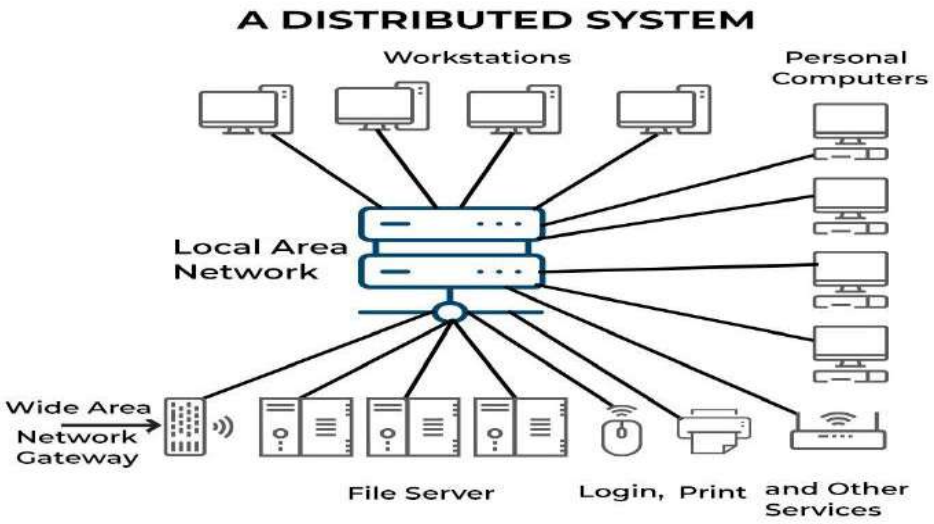

Figure 2: Distributed System

CHALLENGES OF DISTRIBUTED SYSTEMS

Distributed data in dimensions of distributed systems data encroaching dimensions is a remarkable challenge. Scaling data with a backing requirement, ensuring the availability of data with consistency, and maintaining the integrity of the data are some of the challenges posed by distributed data. Some common attempts that surface with the application of advanced technologies and methodologies in dealing with these formidable challenges are through the employment of replication and sharing mechanisms.

Replication is a very basic technique in a distributed environment, which tends to replicate data items over more than one node strategically. Another technique to address the challenges of distributed systems is data sharing mechanisms. Broadly, in this approach, data that is housed within a database is broken down into isolated segments or shards and then these segments are placed across different nodes of the distributed network. However, both techniques were not good enough when dealing with large data.

BIG DATA

According to Aggarwal et al. (2017), Big Data refers to the term that has come with considerable prominence within the IT domain. The emergence of new personal communication technologies and the growth of the online population fueled by the realms of companies like Facebook, Yahoo, Google, and YouTube, have characterized the present needs that one uses for the analysis of large pools of both unstructured and structured data. Google has huge information volumes that require processing by complex databases that are inherent.

According to Shraddha and Maddipatla (2015), Big Data is defined by:

- **Volume:** An amount data goes beyond capacity of relational database infrastructures.
- **Velocity:** The speed at which new data is generated, captured, and shared.
- **Variety:** This involves huge volumes of very different types of data.
- **Veracity:** The unstructured nature of data like hashtags and abbreviations.

CHALLENGES AND OPPORTUNITIES ABOUND WITH BIG DATA

The database context would include data quality, data streams, data relics, data heterogeneity, data models, multi-model databases, portals, and interfaces for clients and query; query computation; tensor computations; optimization; data compression; data encryption; access control; data linking; datasets and other survey objects; data dispersion; data combination; and implementation of the dataset in cluster

computers hosted by the cloud. These include a high-value subset of Big Data; thereby, further, stage in entailing the separating of the untainted data from data corrupted by spam, noise, and bias—an issue of humongous significance.

As per Rogers (2017), many formal methodologies have been developed in performing strategic choice decisions, information system management, and strategic decision-making, for example, TOGAF, IBM's Zachman, and Gartner methodology. They, however, rarely focus or discuss data but on the ways that can be useful in managing a sizable information system.

NoSQL

According to Franks (2012), the inception of NOSQL databases has ever come to meet the demands requiring the managing of complex data in real-time applications where the necessity to remain available is more demanding than to keep it consistent and has been achieved to allow scaling

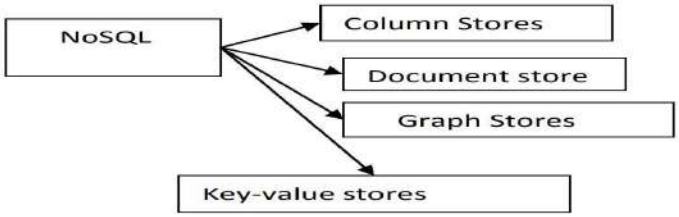

Figure 3: Nosql Praveen et al. (2017).

NoSQL MARKET

The global NoSQL market was valued at USD 7520.13 million in the year 2022 and, according to the forecast report by Technology Insights, the same market through 2028 is expected to register substantial growth with a projected Compound Annual Growth Rate (CAGR) of 31.08%, possibly reaching USD 38144.35 million. This further reflects a thorough assessment of the different aspects that are related to the burgeoning growth narrative operational from broader market dynamics to segment-specific dynamics of NoSQL and competition analysis.

CONCLUSION

In conclusion, as more firms consider the adoption of Big Data Solutions to address their various challenges, it will be necessary to recognize the applicable database model that will suit a certain use case, application, or environment. This implies that companies are encouraged to consider not only Security and Availability aspects but also Consistency Model, Data Model, Query Language and API, Performance and Scalability, Durability and Disaster Recovery, Community and Support, Integration and Ecosystem, Cost and Licensing, Security and Compliance and Vendor Lock-in when adopting Big Data solutions.

REFERENCES

[1] Aggarwal, D., Roopam, & Sonika. (2017). Emerging Technologies For Big Data Processing: NoSQL And NewSQL Data Stores. International Journal of Engineering and Computer Science. From https://www.ijecs.in/index.php/ijecs/article/view/315

[2] Furlan de Oliveira, V., Pessoa, M. A. O., Junqueira, F., & Miyagi, P. E. (2021). SQL and NoSQL Databases in the Context of Industry 4.0. Machines, 10(1), 20. Retrieved From https://doi.org/10.3390/machines10010020 (pp. 1-2).

[3] Ivan, S. (2023). 2023 NoSQL DBaas Performance Comparison Report. Altoros. From https://www.couchbase.com/content/nosql_comparison_web/altoros-report-2023-nosql-dbaas-performance-couchbase-capella-redis-enterprise-cloud

[4] Jain, K., & Mamatha, G. (2023). Implementation of NoSQL in Big Data Marts. J-JSS, 2(1), 1-5, ISSN2583-5815.Retrieved from https://www.researchgate.net/publication/373682721_Implementation_of_NoSQL_in_Big_Data_Marts

[5] Kai, O. (2010): Analysis and Classification of NOSQL Databases and Evaluation of their ability to replace an Object Relational Persistence Layer, Master's Dissertation, Ed.: University of Munchen, Germany. From https://wwwmatthes.in.tum.de/file/ikcuitkq8cpm/Publications/2010/Or10/Or10.pdf

[6] Khatri, V. S. (2022). NoSQL vs SQL in 2024: Comparison, Features, Applications. Retrieved from https://hackr.io/blog/nosql-vs-sql

[7] Mackin, H., Perez, G., & Tappert, C. C. (2016). Adopting NoSQL Databases Using a Quality Attribute Framework and Risks Analysis. In Proceedings of the Fifth International Conference on Telecommunications and Remote Sensing (ICTRS 2016) (pp. 97-104). ISBN: 978-989-758-200-4. DOI: 10.5220/0006227600970104. SCITEPRESS – Science and Technology Publications, Lda. From https://www.scitepress.org/PublishedPapers/2016/62276/62276.pdf

[8] Malik, A., Burney, A., & Ahmed, F. (2020). A Comparative Study of Unstructured Data with SQL and NO-SQL Database Management Systems. Journal of Computer and Communications, 8(4), 1-7. DOI: 10.4236/jcc.2020.84005. Retrieved from https://www.scirp.org/journal/paperinformation?paperid=99539

[9] Praveen, S., Chandra, U., & Wani, A. A. (2017). A Literature Review on Evolving Database. International Journal of Computer Applications, 162(9), 35-41. DOI: 10.5120/ijca2017913365.https://www.researchgate.net/publication/315175936_A_Literature_Review_on_Evolvin g Database

[10] Roger, S. (2014), Microsoft Developer Network Architecture Center,"A Comparison of the Top Four Enterprise Architecture Methodologies", Retrieved From https://download.microsoft.com/download/6/1/C/61C0E37C-F252-4B33-9557-42B90BA3E472/EAComparisonV2-028.PDF

[11] Shraddha, A., and Maddipatla, K. P. (2015): A Transformation from relational databases to big data. International Journal of Engineering and Computer Science ISSN: 2319-7242 4(9), 14378-14381 From https://www.ijecs.in/index.php/ijecs/article/download/3167/2930/

[12] Technology Insights. (2023). NoSQL Market 2024-2031 | Future Trends and Business Developments [LinkedIn post]. Retrieved from https://www.linkedin.com/pulse/nosql-market-2024-2031-future-trends-business-developments-saqmf/