National Research Journal of Information Technology & Information Science
Volume No: 13, Issue No: 1, Year: 2026 (January-June)
PP: 322-329
ISSN: 2350-1278
Peer Reviewed & Refereed Journal (IF: 7.9)
Journal Website www.nrjitis.in

ROLE OF DATABASE IN MODERN APPLICATION:A REVIEW

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ABSTRACT

Database management systems (DBMS) serve as the cornerstone for effective program operations with low risk and are essential to contemporary data organization, distribution, and control. To maximize benefits, optimize performance, and promote knowledge across multiple domains, these systems make use of integration and appropriate programming. DBMS provides creative solutions for a variety of applications by facilitating certification procedures, facilitating simultaneous communication, and supporting the study of dynamic difficulties. The increasing use of database technology is indicative of how they have revolutionized information management. At the heart of DBMS are relational and non-relational databases, each of which is tailored to a particular set of operating requirements. While non-relational databases offer flexibility for managing unstructured data, allowing for the growing volume and complexity of information, relational databases, which are founded on structured data organization, guarantee consistency and dependability. Through the precise and prompt processing of data, DBMS facilitates decision-making in enterprise management, allowing for operational effectiveness and strategic planning.

Keywords: Database, Communication, Relational Database, Database Management System (DBMS), Technology

I. INTRODUCTION

Database technology is widely employed in many different industries and is an essential component of information management and data processing. In the current digital age, handling and processing data has gotten increasingly difficult but necessary as its volume and diversity increase. Databases facilitate better decision-making, increased productivity, and innovation for organizations in a variety of industries including government, business, retail, and education. A structured collection of data that has been arranged to facilitate access and use is called a database. A database, for instance, could be used by an educational institution to record information about students, classes, lectures, and timetables so that pertinent data can be easily retrieved [1]. Specialized software called database management systems (DBMS) aids in the creation, arrangement, and administration of databases. They guarantee that users can obtain timely, relevant, and accurate data for planning and decision-making. Because it makes data storage, maintenance, and security more efficient, database management systems (DBMS) are now essential in modern organizations. Additionally, it facilitates operations by delivering pertinent information at the appropriate moment. To help managers monitor performance and make wise decisions, a multinational corporation employs database management systems (DBMS) to analyze everyday transactions. In a similar vein, databases are used by governments to enhance public services and guarantee data management openness. As the need for new methods to store and use data grew, database technology started to take shape in the 1960s. It has developed into one of the computer fields with the quickest rate of growth over time, influencing how businesses handle information today. Databases are growing ever more potent and available with developments like virtualization and cloud computing.

ISSN: 2350-1278
Peer Reviewed & Refereed Journal (IF: 7.9)
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II. LITERATURE REVIEW

Various research works are available in the literature regarding database management systems. In 1969, GEORGE G. DODD discussed the purposes of data management systems and primitive data management techniques [2]. After that, in 1974, Everest G.C introduced the objective of a database management system. This research work was aimed at business executives and technical information specialists [3]. In 1976, James P. Fry and Edgar H. Sibley presented the evolution of database management systems. [4]. Abraham Silberschatz, Henry F. Korth and S. Sudarshan published their research work in 1996 describing databases, DBMS, and data Models [5]. Authors have unfolded different types of data models, kinds of databases, their applications, and the history of database technology. In [6] the author outlines a process for evaluating and selecting database management software that was designed and implemented. In [2], it is stated that a Deterministic Real-Time Database Management System is required. In [7], The General Data Protection Regulation significantly enhanced the high level of data protection in the researcher's survey. Open data is information that is made available for use for both commercial and non-commercial reasons. Available in an open, machine-readable format to the general population. It is expected that publicly available would promote the data economy and data-driven innovations, especially in the IT services sector and SMEs, while also enhancing public sector transparency. The need for open data has been emphasized by the new European data plan for 2020, including for data that is not held by the public sector. This plan calls for leveraging more open data to boost the EU's single market for data. The researchers claim that, considering the possible effects of these fictitious events, the use of database management solutions has suddenly increased, added that the foundation of database management systems is the advancements achieved through integration. In order to analyze the work, generate improved performance, and organize accreditation, they give vital means of concurrent communication. Effective use of proper programming can increase benefits and incorporate the knowledge that is required to regulate the downward axis of dynamic cuts. Sindhubala Patel et al. (2023) they talk about the necessary conditions, difficulties, and problems that arise; as a result, several database management systems are being developed and are currently being applied [2]. Since there are several DBMSs available, each has unique features, advantages, and disadvantages. The authors conducted a literature review in order to examine different types of DBMSs, their characteristics, and their attributes. This survey's primary goal is to talk about different database management systems from 1960 to 2022. The literature on several database management systems is presented in-depth in this study.

III. DATABASE MANAGEMENT APPROACHES

Software called a Database Management System (DBMS) is made to assist businesses in effectively managing and centralizing their data while facilitating application program access [8]. A database management system (DBMS) serves as a bridge between programs and actual data files, enabling users to access data without being familiar with the technical aspects of storage. For programmers and end users, this division of logical and physical data representations makes data access easier. One popular kind of DBMS is a relational database, which arranges data in tables with rows and columns. Key values are used to create relationships between tables, guaranteeing the consistency and integrity of the data.

A. Relational Database:

Relational database salient characteristics include:

ISSN: 2350-1278
Peer Reviewed & Refereed Journal (IF: 7.9)
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1. Tabular Structure: Information is kept in tables with columns representing attributes and rows representing records.

2. Relationships: Flexible searches are made possible by the connections between data tables via key values.

3. Data reliability: It is maintained via the ACID Properties, which guarantee atomicity, consistency, isolation, and durability.

Relational databases have the following benefits:

1. Transaction support and consistency are essential for sensitive data since they guarantee whether an operation is successful or unsuccessful overall.
2. Complex linkages and queries for multidimensional data are supported by flexible data modelling.
3. Data Constraints and Integrity upholds regulations to preserve consistent and accurate data.
4. SQL Standardization is used for data analysis and retrieval.
5. Data protection is ensured by security and access control, which enables administrators to grant permissions.

B. Non-Relational Database:

Non-Relational database uses "NoSQL" [9] i.e. not only SQL. It does not depend on Structural Query Language. The characteristics of Non-Relational Database are as follows:

1.Schemaless: Data can be stored in Flexible formats without pre-defined structure.

2. Data-Model Variety: Supports multiple models like key-value, column-family and graph database.

3.Distributed Architecture: Data can be stored across multiple servers using replication and sharding.

4. Horizontal Scaling: Scales by adding more servers to the cluster rather than upgrading existing hardware.

Benefits of using non-relational database at application level is as follows:

1. Flexibility: It handles unstructured data very well like data from social media, images, videos etc. It is ideal for agile development as fields and document can be added or removed without schema modification.
2. Scalibility: It stores large volume of data and handles high traffic load with help of horizontal scaling.
3. High Performance: Uses distributed processing and caching for quick response. Responses are faster than SQL query because they do not scan multiple tables [10].
4. Availability and Fault Tolerance: Data remains available even if server fail through replication.

IV. GOALS OF DBMS

In the current world, a database management systems (DBMS) goal is to effectively arrange, store, and handle data in order to satisfy the increasing need for precise, trustworthy, and immediately accessible information. Important goals include:

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Peer Reviewed & Refereed Journal (IF: 7.9)
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1. **Effective Data Management:** By centralizing and organizing massive amounts of data, a database management system (DBMS) guarantees effective storage and retrieval. As businesses manage expanding datasets from many sources, this is essential.
2. **Data accessibility:** Without requiring in-depth technical understanding of storage techniques, it gives users and programs an organized method to access, query, and analyses data.
3. **Data Security:** Sensitive information is shielded against breaches and unwanted access by a database management system's strong security features, which include user authentication, encryption, and access control.
4. **Data Accuracy and Integrity:** Enforcing regulations and limitations guarantees the authenticity and consistency of data, which is essential in industries like e-commerce, healthcare, and finance.
5. **Flexibility and Scalability:** Contemporary DBMS solutions accommodate both structured and unstructured data in a range of formats and are built to grow with an organization's demands.

4.1 Advantages of DBMS

DBMS has a wide variety of advantages which include:

1. **Improved data security**

   Data security measures are very important for any organization. To ensure high data security, companies use DBMS as it provides various levels of security authentication which can be done at the user and admin levels. This helps to avoid security breaches and takes care of the security issues.

2. **Data retrieval**

   DBMS provides a platform that is time-saving and easy to use for organizations. Data can be stored and retrieved quickly and securely within time constraints.

3. **Minimum data inconsistency**

   Data inconsistency occurs when there are different versions of the same data stored at different places. For example, data inconsistency exists when let’s say a school’s database has the name of the Principal as 'Raman Desai' at one place and it’s 'Naman Desai' at the other place. Here, there’s an inconsistency as the principal is the same and it should be the same at all places in a database. Such errors are highly minimized in a properly designed DBMS.

4. **Improved decision making**

   DBMS provides high data quality by minimizing data inconsistency and improving data security. This ensures that there are fewer errors and high accuracy rate is maintained. Thus, DBMS helps businesses to improve upon their decisions that are backed by the data in a DBMS.

5. **Better data sharing facility**

   DBMS ensures that users have access to the data and they can view the changes happening in the data which helps the end-user to respond to such updates in the database quickly.

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4.2 Disadvantages of DBMS

Apart from the advantages, there are a few demerits of using DBMS.

1. **Expensive**

   DBMS requires highly professional staff, sophisticated hardware and software that makes it quite expensive to implement and maintain. Also, training costs for staff and licensing costs are significant ones that add to the total cost of DBMS operations. Thus, heavy investment in database technology results in DBMS being expensive.

2. **Complexity issues**

   DBMS is very complex to operate and manage. It requires skilled person to maintain, so it's difficult for non-technical people to understand it's working. If one doesn't use DBMS properly, then there can be system failure issues. These issues can lead to database failure or data loss.

3. **Not Beneficial for small firms**

   DBMS is designed to be useful for large organizations. Generally, traditional file systems work better for small-scale firms as compared to DBMS. This is because the performance of DBMS is slow for small firms. Also, it's quite expensive for them to use DBMS.

4. **Frequent upgrade issue**

   As updates occur in a system, new features are added to its functionality. This makes it necessary for staff to learn about these software and hardware upgrades. As in today's world, changes occur rapidly, so it takes time, effort, and cost for organizations to train their staff.

V. CHALLENGES IN DBMS

Although databases are crucial for data management, they have a number of drawbacks in today's world:

1. **Expensive initial outlay:** Setting up a database management system requires a huge investment in software, technology, and qualified staff, particularly for large-scale applications. For small organizations, the cost of licensing sophisticated DBMS software can be prohibitive.
2. **Design and maintenance complexity:** Creating a well-structured database is a difficult task that calls for experience. Errors and inefficiencies can result from poorly built databases. Operational complexity is increased by routine maintenance, upgrades, and optimization.
3. **Scalability Challenges:** The exponential rise of data in contemporary applications, especially unstructured data like photos, videos, or Internet of Things data, may be too much for traditional relational databases to manage. Migration is frequently necessary for upgrading to scalable systems, and it can be dangerous and time-consuming.
4. **Vulnerabilities in security:** Cyberattacks frequently target databases [11]. Sensitive information may be revealed by breaches, harming a company's finances and reputation. Strong security necessitates ongoing observation and cutting-edge defenses, both of which might demand a lot of resources.

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5. **Bottlenecks in performance:** Performance may deteriorate with an increase in concurrent users or transactions, resulting in sluggish query replies or system breakdowns. High-end hardware and knowledgeable administrators are frequently needed for high-performance optimization.

VI. FUTURE ASPECTS

DBMS is changing to meet new opportunities and challenges as technology advances. The following are some important facts and paths for DBMS development in the future:

1. **Connectivity to Cloud Computing**: Because of their scalability, affordability, and flexibility, cloud-based DBMS systems are becoming more and more popular. Large databases can be accessed and stored remotely by organizations, negating the need for costly on-premise infrastructure.
2. **Big Data Administration**: Big data is growing, and DBMS need to be able to manage enormous datasets effectively [12]. Big data tools like Hadoop and Spark will be integrated into advanced systems to handle and analyze unstructured data.
3. **Integration of AI and Machine Learning:** AI and machine learning will be used by future DBMS to automate predictive analytics, anomaly detection, and database optimization [13]. Based on usage patterns, intelligent systems can suggest database architectures and self-tune performance.
4. **Non-Relational Database Support:** The significance of non-relational (NoSQL) databases [14], such as document-based or graph databases, will only increase. These systems manage unstructured, semi-structured, or dynamic data all of which are becoming more and more prevalent in contemporary applications.
5. **Improved Security of Data:** DBMS will include enhanced security features like multi-factor authentication, end-to-end encryption, and AI-based threat detection in response to more stringent data protection laws like the CCPA and GDPR [15].
6. **De-centralized and Dispersed Databases:** Businesses will be able to store data in numerous places thanks to distributed database management systems, which will increase scalability and fault tolerance. By enabling decentralized, immutable databases for particular use cases, blockchain technology will also have an impact on DBMS.

VII. CONCLUSION

With applications in a variety of sectors, including company management, retail, education, and government services, database technology has emerged as a crucial instrument in contemporary information management. It streamlines data organization, storage and retrieval, assisting people and organizations in improving efficiency, planning, and decision-making. Databases are used in enterprise management to handle customer and staff data, expedite corporate procedures, and support strategic planning. Databases are used by retailers to track sales, manage inventory, and improve customer experiences. Databases in education facilitate the management of online learning platforms and student records. Databases facilitate effective crisis management, guarantee openness, and enhance data sharing for public services and government. With its expanding global economy, India has a huge demand for efficient database systems. Even though the nation produces a lot of information, large portion of it is still trapped in antiquated paper records. By using database technology, this information may be unlocked and made more usable and accessible. Additionally, it can incorporate data into bigger systems, such as big data analytics, which is advantageous for

ISSN: 2350-1278
Peer Reviewed & Refereed Journal (IF: 7.9)
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both public services and industry. Databases are changing in tandem with technological breakthroughs. With capabilities like real-time data processing, cloud integration, and AI-driven analysis, modern systems are growing in strength, security, and intelligence. These enhancements will tackle issues including scalability, data security, and the requirement for intuitive user interfaces. Databases will continue to be essential for advancing innovation and advancement as the need for structured data increases. Societies and organizations can achieve greater heights in information management and utilization, increase efficiency, and open up new opportunities by adopting these technologies. In conclusion, database technology serves as both a platform for future advancements across businesses and a tool for managing data. It has enormous potential to boost output, aid in decision-making, and promote development across the board.

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