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Original Article

A Survey on the Use of MySQL and MongoDB in Data-Driven Applications for Small and Medium Enterprises

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Abstract

The rapid increase in the digitization of data has changed the manner in which Small and Medium Enterprises (SMEs) interact and perceive information. Effective database systems are critical in establishing efficacy in operations, scalability and management of information with secure information management. The given paper is a comparative analysis of relational (SQL-based) and non-relational (NoSQL-based) database management systems focusing on MySQL and MongoDB, two of the most popular solutions in the SMEs. MySQL is a good example of relational databases that have gained popularity due to their maturity, ACID compliance, organized schema handling, and community support features, which have made relational databases appropriate in financial, transactional and inventory-based applications. MongoDB, the most popular NoSQL database, by contrast, is flexible in its schema, horizontally scaled, and high-performing when it comes to handling unstructured and semi-structured data, and is thus especially useful with dynamic, data-intensive apps, like those of social networks, forums, and IoT. In addition, the research paper evaluates database selection criteria used in SMEs such as cost-effectiveness, scalability, readily integrates, transaction integrity, and security. The conclusions highlight that MySQL is more reliable and consistent in structured data applications, whereas MongoDB is more flexible and adaptable in user-driven and fast-evolving environments. Finally, the database selection determined by the character of SME functioning, availability of resources, and future possibilities of scaling.

Keywords

MySQL, MongoDB, Small and Medium Enterprises (SMEs), Database Management Systems, Relational Database, NoSQL Database.

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1. Introduction

In the modern fast-changing technological world, the use of data mining and business intelligence (BI) technologies has indeed revolutionized organizational functions, especially in small and medium-sized businesses (SMEs) that constitute the largest number of businesses in the world today and are a major source of workforce. They are very important in inciting innovation, diversification as well as assisting in poverty reduction [1]. Globalization and digitalization, put differently, lead SMEs to rely on digital platforms and e-commerce, as well as data-based strategies, in order to stay competitive. Nonetheless, in spite of such trends, the use of high-tech applications like Big Data Analytics has not pervaded SMEs yet [2]. SMEs have various forms of data, and these need effective database management systems. MySQL and MongoDB offer varying capabilities, and choosing the appropriate system is the key to success, improved decision-making, and long-term competitiveness.

The role of data management in SME is increased by the fact that in this case, the scope of resource utilization can be the main constraint of using advanced technologies [3]. The efficiency of work, scalability, and sustainable growth can be provided by streamlined data management. It cuts across the spectrum of activities of creating and storing data to its analysis to make strategic decisions [4]. Nevertheless, the unavailability of scalable and affordable

solutions in line with the SME development patterns and business goals is a major challenge. Data-driven applications fill this gap by helping organizations to make evidence-based decisions using a combination of structured and unstructured data.

The key to this process is a Database Management System (DBMS). It enables the effective storage, retrieval as well as manipulation of data in compliance with other rules like availability, reliability, scalability, manageability, security and flexibility [5]. DBMS has a number of benefits, such as not being dependent on application-specific structures, minimizing record duplication, enhancing accuracy via automated updates, and parallel processing and clustering [6]. MySQL and PostgreSQL are among the Relational Database Management Systems that have been widely used because of their reliability, effective classification and high performance in data navigation and sorting [7].

MySQL is specifically one of the most popular open-source relational databases around the world, and it is appreciated due to its stability and affordability. On one hand, the NoSQL database systems such as the MongoDB provide flexibility in manipulating semi-structured and unstructured data, and can be used in the case of modern, dynamic applications. MySQL and MongoDB can handle various data management requirements, and comparing their pros and cons and applicability is very crucial when SMEs are in pursuit of long-term expansion.

This survey investigates how MySQL and MongoDB are used in data-driven apps that are adapted to SMEs. It includes a detailed overview of their characteristics, advantages, and disadvantages alongside pointing out real-world application areas in business spheres. The comparison of MySQL and MongoDB based on their performance, scalability, cost, and ease of adoption to inform the SMEs on the decisions that they should make concerning the technologies of databases. Moreover, the survey explores issues, best practices, and innovations and provides information to assist SMEs in developing sustainable, data-driven ecosystems.

A. Organization of the Paper

The paper has been structured in the following way: Section II the role of database management systems in SMEs, objectives and scope of the survey. Section III provides a summary of MySQL for SME. Section IV: MongoDB for SME. Section V gives an Application of MySQL and MongoDB in SME applications. Section VI is a literature review and case studies, and Section VI summarizes the main results and the research directions.

2. Understanding Of Database Systems

A database is a systematized mass of information, which is operated by a Database Management System (DBMS), to allow numerous people to store, retrieve, and manipulate information effectively. DBMSs have basic features like concurrent access, data integrity and query processing enhancing velocity, convenience, and general information management. A database design is important in order to maintain efficient information processing, reduction of redundancy, and correct decision-making processes. It is under the administration of databases that a great development was witnessed through the establishment of RDBMS that became the default in the administration of structured data through tables, rows, and columns [8]. The growing range of data types, such as semi-structured and unstructured data, as well as additional application needs, however, made the traditional RDBMS solutions look limiting. It gave rise to the so-called NoSQL (Not Only SQL) databases that embrace more flexible and non-relational models, including key-value stores, document stores, columnar databases and graph databases, delivering scalability, flexibility at the schema, and high performance to data-intensive applications in the present day.

A. Relational vs. Non-Relational Databases

Relational databases, which are also known as Relational Database Management Systems (RDBMS) or just "SQL databases," have traditionally been the most popular choice for business apps. Microsoft SQL Server, Oracle Database, MySQL, and IBM DB2 are among the most popular systems. Even though most relational database management systems are utilized in enterprise-level settings, MySQL's open-source nature and simplicity of implementation have made it a popular choice for powering web applications. A relational database management system (RDBMS) organizes and retrieves data efficiently by storing it in organized tables with rows and columns. One of the key strengths of relational databases lies in their flexibility: they make relatively few assumptions about how data is related, allowing users to query and view the same dataset in multiple ways [9]. Furthermore, relational systems support data distribution across multiple tables, ensuring reduced redundancy and logical organization. This design

contrasts with flat-file databases, where all data is confined to a single self-contained table, often leading to duplication and inefficiencies in handling complex relationships.

NoSQL databases, which are not relational, differ from RDBMS in that they provide more adaptable data models that can deal with both organized and unstructured data, as opposed to RDBMS's inflexible, table-based schemas. Horizontal scalability, schema-free or schema-on-read models, high availability, and quick performance at scale are the main goals of NoSQL databases, in contrast to relational systems that prioritize ACID compliance, rigid schema design, and data integrity [10]. Some NoSQL systems even support ACID transactions, but many instead adopt, that trades immediate consistency for scalability and speed. However, these benefits come with drawbacks: weaker or eventual consistency, limited support for joins and indexing, reliance on denormalized data models requiring mass updates, lack of built-in data integrity, and potentially high training, setup, and development costs, despite many solutions being open source.

B. Structured Query Language (SQL) Overview

SQL is the de facto language for working with RDS. By itself, SQL does not constitute a Database Management System (DBMS); rather, it serves as a communication medium between the user and the DBMS. The basic actions that users can execute with SQL commands, which are composed of statements that sound like English, include querying, inserting, updating, and removing data [11]. One of the most widely adopted relational DBMS implementations is MySQL, an open-source project that has been publicly available since 1996, though its development roots extend back to 1979. MySQL provides robust capabilities for data storage, searching, sorting, and retrieval, making it one of the most popular database solutions in both academic and industrial contexts. It is attractive because of a variety of features, such as high performance, ease of use, robust query language, wide connectivity, security and portability [12]. The increasing popularity of MySQL as a database in the global community is an indication of its capability to address a broad range of application needs.

C. NoSQL Databases Overview

NoSQL or non-relational databases, also referred to as Not Only SQL or NoSQL, were developed to overcome the limitations of handling huge volumes of diverse and rapidly changing data in relational databases. They are made to counter the shortcomings of relational systems by providing high performance, flexibility of schema, availability, replication, and scalability, and so best suited to address the three Vs of big data volume, variety, and velocity [13]. Document databases, particularly because of their capacity to store data in semi-structured formats, like either JSON or BSON, have become quite popular as they allow flexibility in schema management and simplify the development of applications [14]. The leading NoSQL document databases are MongoDB, Couchbase, and CouchDB, each offering unique strengths in scalability, performance, and ease of use.

A distinguishing strength of NoSQL lies in its variety of data models, which cater to different application requirements:

- Document Databases (e.g., MongoDB, Couchbase): Use data types similar to JSON or BSON for schema management flexibility.
- Key-Value Stores (e.g., Redis, Riak): Offer lightweight, high-speed data retrieval through simple key-based access.
- Column-Oriented Databases (e.g., Cassandra, HBase): Support large-scale analytical queries and distributed storage.
- Graph Databases (e.g., Neo4j, Orient DB): Ensure optimal performance for recommendation and social network enquiries that centre on relationships.

D. Database Selection in SMEs

The process of selecting an appropriate database system is a critical decision for SMEs, as it directly impacts their ability to manage data effectively, support business operations, and scale with growth [15]. SMEs have limited budgets, technical expertise and require effective solutions that are cost-efficient and reliable unlike large organizations which have wide IT resources. Several factors influence:

- Nature of Data: Relational databases (e.g., MySQL) are more appropriate in case the business functions with structured data (financial records, inventories, or customer information). In the case of semi-structured or

unstructured data (e.g. social media content or IoT sensor streams) [16] NoSQL solutions (e.g., MongoDB) are more suitable.

- Scalability Requirements: Databases that support horizontal scalability may be desirable to SMEs who anticipate a high rate of growth and avoid the need to reconfigure databases extensively.
- Transaction Integrity: Relational systems are useful in applications that demand a high level of ACID compliance (e.g., e-commerce transactions, accounting), whereas NoSQL systems can be used in applications where high performance and flexibility are important.
- Cost and Licensing: MySQL and MongoDB are open-source tools that are not only cheaper to implement in terms of initial investment but also offer a vast pool of community resources, which is what SMEs appreciate.
- Ease of Deployment and Maintenance: SMEs tend to have small IT departments and therefore prefer databases that offer easy-to-use tools, integrate with the clouds and have low maintenance costs.
- Security and Compliance: Encryption, role-based access control, and backup procedures are essential aspects that databases should have. This is especially true for regulated areas where SMEs operate.

3. MySQL for Small and Medium Enterprises

The open-source RDBMS MySQL was created by MySQL AB and subsequently acquired by Oracle Corporation. The relational model is utilised by MySQL, which stores data in rows and columns of organized tables and employs SQL for the purpose of data definition and manipulation. MySQL is recognized for being easy to use, reliable, and having a large active community. Common features of MySQL are multi-user support, indexing, replication, stored procedures, and triggers, and security such as user authentication and access privileges [17]. A fully integrated, ACID-compliant database, MySQL supports complete commit, rollback, crash recovery, and row-level locking. One affordable option is the MySQL Database, which is ideal for:

- E-commerce and Web/Cloud/SaaS apps with high speed and scalability [18].
- Applications for Data Mart and Corporate Departmental OLTP
- Big Data repository (Hadoop) integration with operational data store.
- Reliable embedded database applications with minimal administration requirements and excellent performance.

A. MySQL Database features

The MySQL database has the following capabilities:

- High-volume applications' availability, performance, and scalability can be enhanced by self-healing replication clusters.
- The ability to scale and perform well under increasing data loads and user concurrency.
- Dynamic applications that require constant availability for updates can benefit from online DDL/schema changes.
- SQL and non-SQL databases for use in programs that can quickly and easily perform both simple key-value operations and complicated queries on the same transactional information.
- The native JSON format facilitates schema-less data storage, retrieval, and manipulation that is both efficient and versatile.
- Performance Schema for tracking how well applications and users use system resources.
- Hadoop and other Big Data platform installations rely on MySQL as their operational data store, and platform interoperability makes it possible for MySQL to function across operating systems.

B. Strengths of MySQL in SME applications

MySQL offers SMEs a balance of structured data management, reliability through ACID compliance, and cost-effectiveness as an open-source solution are as follows:

(a) Handling Structured Data

MySQL is adept at dealing with structured data that follows the rules of pre-defined schemas. This is particularly useful for SMEs working within a more traditional domain of financial transactions, inventory systems, and customer relationship management systems where the application of structure and consistency of the underlying data is necessary.

(b) ACID Compliant / Transactionality

MySQL is designed in a way that it fulfils the ACID (Atomicity, Consistency, Isolation, Durability). It works well when it comes to handling transactions in a way that can be deemed to be reliable. Applications that demand high accuracy of data in data-centric applications, e.g., e-commerce transactions and data record keeping, would require MySQL.

(c) Affordability (Open Source)

The open-source organization significantly reduces licensing costs of MySQL, which is desirable for SMEs with limited budgets for software solutions [19]. Additionally, the availability of a large developer community, documentation, and available tools to support this technology all contribute to the total cost of ownership being manageable.

C. Advantages and Disadvantages for SMEs (maturity, community support, integration)

(a) Advantages of SQL

SQL-based relational database systems, such as MySQL, provide several advantages that make them attractive for Small and Medium Enterprises (SMEs).

- Maturity and Dependability: SQL databases are also among the oldest and most developed database technologies; decades old, solid stability, and reliability in most industries.
- Community Support and Ecosystem: SQL is widely used that offering an established developer community base, outstanding documentation and ecosystem of tools and libraries that can aid in reducing the learning curve of the SME with scarce IT resources.
- Integration and Compatibility: A majority of enterprise software or programming languages and frameworks that the SMEs might need to use have good SQL database support that enables easy integration into current workflows of the SME.
- Data Consistency: Relational model offering a high degree of assurance of ACID (Atomicity, Consistency, Isolation, Durability) properties, which are important in transactional integrity: this is particularly relevant in the case of SMEs handling financial transactions, keeping a customer record and inventory management.
- Portability: SQL also offers a standardized language format that renders an application more or less portable to various SQL-based systems.

(b) Disadvantages of SQL

Despite its strengths, SQL also presents challenges for SMEs, especially in the context of modern, data-intensive applications:

Technical matters necessitate substantial investment of work to master SQL and craft task-specific code. When individuals use social media to update their profiles, upload new images or videos, or add friends, the amount of data is constantly growing. Due to the massive amount of data, the relational database—which is optimized for small, organized datasets stored on a single server—is ill-suited [20]. The massive amount of data that social networks process means that their operation times are severely limited. To conduct a query, however, data retrieval from the hard drive is required because SQL is based on a two-dimensional table structure that merely comprises rows and columns. Also, join operations are common and time-consuming in classical SQL [21]. When thinking about this for business purposes, APIs are the third crucial component that SQL isn't great at supporting. As a result of these drawbacks, NoSQL is often used.

4. MongoDB for Small and Medium Enterprises

One of the major databases, MongoDB is an open-source document-oriented NoSQL database that was published in 2009. It stores data in JSON-like objects and features a dynamic schema, scalability, query performance, indexing speed, and active community support [22]. It efficiently manages both small- and large-scale data, with collections consisting of documents represented as key–value pairs, where schema flexibility allows documents in the same collection to differ in structure [23]. The performance, scalability, and versatility of MongoDB are highly regarded in data-driven applications. It has been widely used by organizations like Vodafone, Bosch, SAP, CISCO, eBay, Google, and Sage [24]. Its document-oriented model enables high read/write throughput, making it suitable for big data, cloud, social media, and IoT environments.

A. Using MongoDB Social networking Website

The social networking website is depicted in Figure 1.Websites like these rely on the participation of numerous users, hence the primary features can be categorized as People/Profile, Post/Blog, Media/Image/video/Audio [25], Relations/Interactions, and APIs;

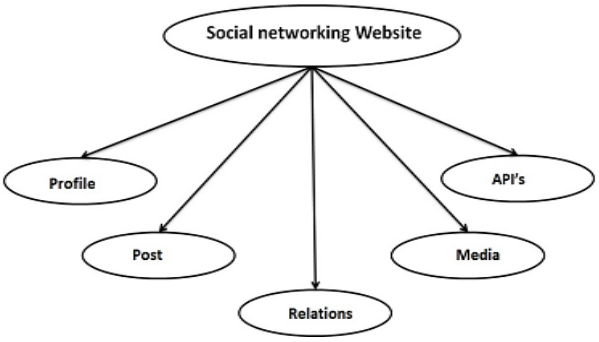

Fig-1: Modules of Social Networking Website

- Profile: This section gathers data pertaining to the users, including their names, ages, sexes, and places of residence, as well as their educational and occupational backgrounds [26]. With these details, a person can be identified on the social media platform. Users can connect with one another through this identification.
- Post: The ability to edit and publish content is provided by this component. Bloggers, tweeters, etc., are all examples of online content creators. One of his experiences can be published as well.
- Media: Media consists of a user's desired means of sharing information with others, including images, audio, and video. A user's primary focus should be on media.
- Relations: Interactions or relations can be defined as the number of likes, shares, comments, etc., that a blog post or post receives.
- API's: Web applications that facilitate communication between various online services provide APIs to social media websites [27]. Since APIs constitute the backbone of most social media platforms, it would be foolish to disregard them.

B. Advantages of MongoDB Compared to SQL

One advantage of MongoDB over traditional SQL is the relative ease with which technical staff can begin developing their skills in this area. Then, scalability is a major perk for businesses that use MongoDB. By sharding, or distributing data records over several computer nodes, users can handle massive amounts of data as they increase in volume and the number of read/write operations they need to do [28]. Finally, MongoDB is a document-oriented database that allows for a large number of fields to be associated with a single collection of documents. One document may differ from another in terms of size and content.

Furthermore, indexes can be defined at the collection level and supported on any document field in MongoDB, allowing for more efficient query execution. That is, in order to uniquely identify each document, MongoDB automatically produces a primary key (id). In theory, the id and document function similarly to a key-value pair. Furthermore, MongoDB makes an effort to save the majority of its data in memory; in order to reduce the time, it takes to execute simple queries. This is achieved by avoiding the need to retrieve data from the hard disc. One useful aspect of MongoDB's API is that its document store format is well-suited to the object structure that APIs return or process when making a "get" or "post" request.

C. MongoDB Security Features

Authentication, authorization, auditing, network exposure, and injection protection are some of the built-in security mechanisms utilized to prevent prevalent database attacks in MongoDB (version 3.4).

(a) Authentication

Database security relies on user authentication to restrict access to stored data to authorized users only. As a default authentication technique in MongoDB, SCRAM-SHA-1 is used. This is a challenge-response system for password-based authentication that has been officially defined by the Internet Engineering Task Force (IETF). Prior

to version 3.0, MongoDB employed the MongoDB Challenge-Response method, which has since been deprecated due to its weaker security guarantees.

(b) Authorisation

A prerequisite for authorization in MongoDB is the authentication procedure, which is depicted in Figure 2. Reliable identification of distinct user instances is guaranteed by authentication. After users are recognized, they can be given specified roles that provide access to various resources in MongoDB. Users' permissions to access certain collections and databases are defined by their roles, which may be found in the admin database. New user creation and role assignment are the responsibility of database administrators. For various purposes, they can use the built-in roles in MongoDB or even construct their own custom roles. Proper role assignment limits user behavior, reducing the potential damage if a single account is compromised.

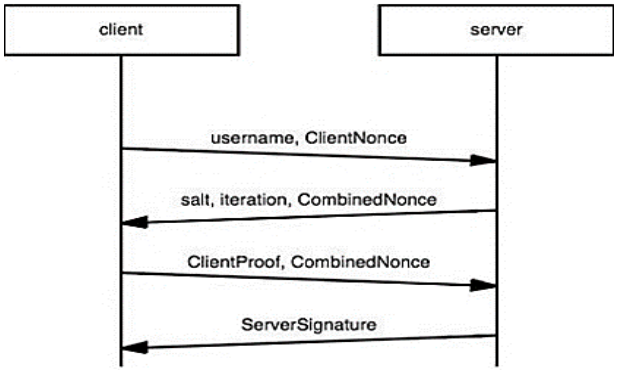

Fig-2: A Visualisation of the Exchange of Messages During an Authentication Session

(c) Encryption

MongoDB is compatible with two distinct encryption methods. It employs Advanced Encryption Standard 256-CBC by default, which is AES-CBC in Cipher Block Chaining mode (for a conceptual description of AES-CBC operations, see Figure 3). When encrypting data, two distinct kinds of keys are utilized: master keys and database keys. By utilizing the master key to encrypt the database keys, which are subsequently used to encrypt the database contents. If wants to secure every field or document in MongoDB, can either use one of their partner solutions or write encryption/decryption methods, according to the documentation. To further secure network traffic, MongoDB is compatible with transport encryption protocols like TLS and SSL. Using OpenSSL libraries, TLS/SSL implementations exclusively use SSL ciphers with keys that are at least 128 bits long.

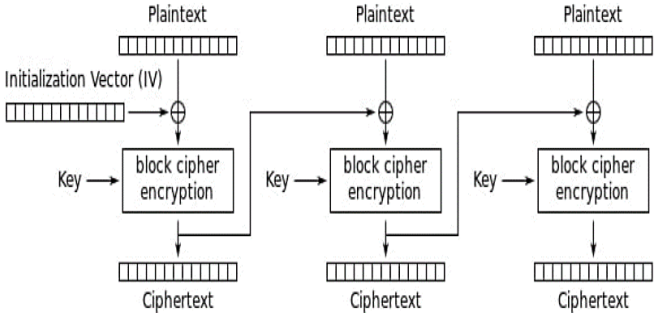

Fig-3: A Conceptual Model of how AES-CBC Operates

(d) Network Exposure

MongoDB should be set up so that it doesn't expose too much of the network. This can be done by only letting authorized clients join and running it on a trusted network. By default, MongoDB restricts network access to localhost, following best practices, but in real-world applications, remote access is often required. Therefore, prior to exposing the database to external networks, it is imperative to implement authentication, authorization, and other security measures. Once MongoDB is up and running on a network, only authorized users should be able to connect to it across firewalls or virtual private networks. To further protect MongoDB deployments against automated attacks, it is advised to alter the default port.

(e) Injection Prevention

MongoDB is susceptible to injection attacks, although not all types of injections are feasible as a result of its inherent security features. However, other forms of injection, such as HTTP trespassing and JavaScript injections, remain possible. As illustrated in Figure 4, which schematically shows how injection hacking can proceed, an attacker can inject malicious input through a web browser, which is then processed by the web server, client/protocol wrapper, and eventually reaches the NoSQL data store. The CodeScope mechanism should be used when user-supplied values need to be sent to a where clause in order to avoid these kinds of attacks, and care should be exercised when utilizing operations like where, mapReduce, and group that permit arbitrary execution of JavaScript.

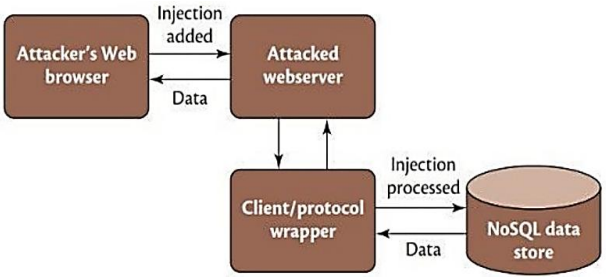

Fig-4: A Schematic Showing How the Process of Injection Hacking Proceeds.

5. Applications of Mysql and Mongodb in Smes.

Small and Medium Enterprises (SMEs) often require database solutions that balance cost-efficiency, scalability, and flexibility. An analysis of a forum application that dynamically changes its structure to user preferences reveals the merits and limitations of MongoDB and MySQL in a comparison study.

A. Forum Development with MySQL (Relational Database)

Using MySQL, the forum structure follows a rigid schema: Forum → Subforum → Discussion → Comments

As illustrated in Figure 5, each user may create a different number of subforums, but the creation sequence remains fixed [29]. This ensures consistency and reliability, which is advantageous for SMEs that:

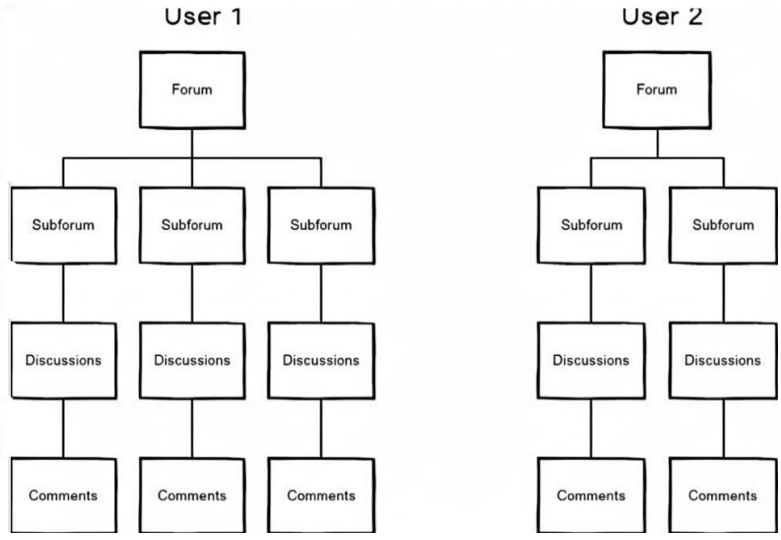

Fig-5: Forum Structure using MySQL

- Require predictable structures for reporting and analytics.
- Need transactional integrity (ACID compliance), e.g., for financial data.
- Have limited IT staff, benefiting from MySQL's wide adoption, community support, and mature ecosystem. On the other hand, this inflexibility could be limiting for SMEs working with user-driven apps that are dynamic.

However, SMEs dealing with dynamic user-driven applications may find this rigidity restrictive.

B. Forum Development with MongoDB (Non-Relational Database)

MongoDB, launched in 2009, is a NoSQL, document-oriented database designed for applications requiring scalability and schema flexibility. Unlike MySQL, it stores data in collections of BSON documents without predefined schemas. For SMEs, MongoDB offers:

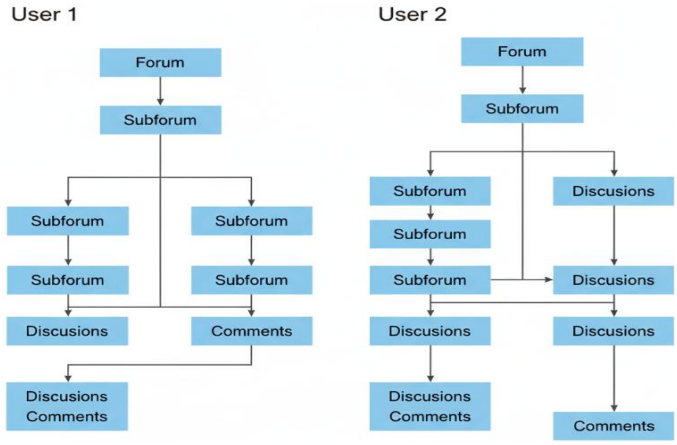

Fig-6: Forum Structure using MongoDB

- Dynamic structure using MongoDB: Forums can be modelled flexibly, as shown in Figure 6 (e.g., discussions may be attached directly to forums, or subforums can be nested indefinitely).
- Faster development cycles: Schema-less design reduces the overhead of schema migrations, important for SMEs iterating rapidly on product features.
- Scalability: MongoDB is well-suited for SMEs expecting rapid growth in user base or data volume (e.g., e-commerce platforms, customer engagement forums).
- Adoption by industry: leaders (Craigslist, eBay, Foursquare, New York Times) demonstrates its production-level reliability.

C. Framework Integration for SMEs

The forum application was developed using Symfony2, an open-source PHP framework that is particularly attractive for SMEs due to its low implementation cost, strong community support, and modular integration capabilities. The integration of MongoDB within Symfony2 was achieved through the use of a bundle an auxiliary package designed to extend framework functionality [30]. Once integrated, the database configuration process proved to be straightforward and efficient. Unlike traditional relational databases, where defining schemas and handling structural changes can be resource-intensive, MongoDB allows databases to be created automatically when first referenced. This significantly reduces the administrative burden on SMEs, which often operate with limited infrastructure budgets and smaller development teams.

6. Literature Review

This review highlights key trends, findings, and comparative insights from existing studies on MySQL and MongoDB, providing guidance for SMEs in selecting suitable database solutions and informing future research and practical implementations in data-driven applications.

Patel et al. (2020) MySQL, Oracle, and MS SQL are examples of SQL databases that are table-based; in contrast, NoSQL databases are document-based, key-value based, graph databases (e.g., MongoDB, CouchDB, etc.) This section presents two comparisons, have two applications that compare the performance of MongoDB and MySQL with respect to insert, read, update, and delete operations. One is a desktop software that uses the Python language, while the other is a web project that uses PHP. While there isn't a huge gap between the two databases, it is clear that MongoDB outperforms MySQL for inserting, updating, and deleting data, and for selection (data fetching) operations. Even if MySQL select operations often take more time than MongoDB ones [31].

Jose and Abraham (2020) focus on the benefits of NoSQL databases over relational databases in big data research by comparing the two systems' performance with a variety of queries and commands in two datasets of varying sizes.

When dealing with massive amounts of diverse data, relational databases weaken. With relational databases like MySQL, data is stored in an organized fashion. There are document-based data stores that can store massive amounts of data, such as MongoDB, a form of NoSQL database. These stores also offer powerful query engines and indexing capabilities [32].

Prasanna et al. (2019) explore the relationship between small and medium-sized enterprise (SME) technical advancement and SME survival and improvement in global competition by conducting a systematic evaluation of literature on the topic of SMEs and technology. Social capital, links to MNCs and TNCs, creativity, sharing and networking, IT, and adoption of productivity-enhancing technologies were the six driving elements found in the review that influence technological upgrade in SMEs. Additionally, the assessment highlighted two factors that are necessary for technological adaptation to be effective in the SME sector: first, an economically viable pool of workers with the necessary technical skills, and second, the capacity to spot opportunities presented by emerging technology in the marketplace [33].

Bocconcelli et al. (2018) indicate that there has been a lot of focus in the marketing and management literature on the marketing of SMEs as of late. The results show that there is a lack of study on particular marketing strategies, but they also show that networks and ICTs are playing an increasingly important role in the marketing behaviour of SMEs. Although entrepreneurial marketing has served as the primary theoretical framework for the studies that have been evaluated, there is still a noticeable gap between the theoretical foundations of these contributions and the research on the marketing strategies and tactics employed by SMEs [34].

Reniers, Rafique, et al. (2017) introduced a novel stream mapping scheme that is based on the distinctive characteristics of MongoDB, a popular document storage in the current market, to address that issue. The proposal technique is independent of data models and workloads and has minimal overhead. They evaluate their proposal approaches using YCSB and Linkbench with a variety of cache sizes and workloads. In the YCSB and Linkbench, methodologies reduced 99th-percentile latency by up to 29% and 24.67%, respectively, and improved throughput by over 44% and 43.73%. Furthermore, the throughput can be considerably enhanced by 3.37x and 2.14x in YCSB and Linkbench, respectively, by adjusting the leaf page size in B+Tree of MongoDB [35 - 53].

Grover and Johari (2016) compared and contrasted the two open-source RDBMS (Relational Database Management Systems) MongoDB and MySQL. Database operations, including insertion, deletion, and selection, were employed to compare the two databases. It is accurate that the database used in the application is wholly determined by database operations. They observed that MySQL outperformed MongoDB in certain applications and database operations, while MongoDB outperformed MySQL in others. Tested the efficacy and performance of both the RDBMS and the database operation execution time by obtaining the real-time traces of the diabetic dataset, which consists of 100,000 records with 51 columns, for evaluation and analysis [36].

The recent studies on MySQL and MongoDB are summarised in Table 1, which emphasises their approaches, main findings, challenges, and future directions in SME data-driven applications

Table 1: Literature Summary on MySQL vs MongoDB in Data-Driven Applications for SMEs.

Reference	Study on	Approaches	Findings/Insights	Objectives	Challenges
Patel et al. (2020)	Performance comparison of MySQL vs MongoDB	Desktop app (Python) & Web app (PHP) tested on CRUD operations	MongoDB outperformed MySQL in Insert, Update, Delete; MongoDB slightly better in Select	To analyze operational performance of SQL vs NoSQL	Limited to CRUD; does not cover scalability or complex queries
Jose & Abraham (2020)	Advantages of NoSQL over SQL in Big Data	Performance comparison on different datasets of varying sizes	NoSQL (MongoDB) handles large, diverse datasets better; powerful indexing & query features	To demonstrate NoSQL efficiency over relational DBs for Big Data	Lack of exploration in hybrid models; only MongoDB vs MySQL

Prasanna et al. (2019)	SMEs' technological adoption & survival	Systematic literature review	Driving forces: social capital, innovation, IT, networking, MNC/TNC links; Key conditions: skilled workforce, new tech opportunities	To identify technological progress impact on SMEs	Findings are conceptual, not empirically validated
Bocconcelli et al. (2018)	SMEs' marketing practices in global context	Review of management & marketing literature	ICT & networks are crucial for SME marketing; research gap in entrepreneurial marketing practices	To highlight role of networks/ICT in SME marketing	The gap between theory and SME practical marketing behavior
Reniers, Rafique et al. (2017)	Improving MongoDB efficiency	Proposed novel stream mapping scheme + B+Tree leaf tuning	Throughput improved (44%+), latency reduced (up to 29%); B+Tree tuning gave 3.37x/2.14x gain	To optimize MongoDB performance	Evaluation only on YCSB & Linkbench; limited workloads
Grover & Johari (2016)	Comparison of open-source RDBMS: MySQL vs. MongoDB	Assessment of database operations (insertion, deletion, and selection) on a 51-column, 100,000-record real-time diabetes dataset	MySQL outperformed MongoDB in some operations/applications; MongoDB performed better in others. Performance depends on type of operation and application requirements	To determine efficiency and suitability of MySQL and MongoDB for various database operations in real-time datasets	Handling large datasets with multiple columns; identifying which DBMS is better suited for specific operations; balancing performance across different types of operations

7. Conclusion and Future Work

MySQL and MongoDB highlight complementary strengths in meeting the diverse needs of SMEs. MySQL, as a mature relational database, offers reliability, ACID-compliant transaction processing, and strong community support, making it highly effective for structured data applications such as financial systems, e-commerce, and customer relationship management. In contrast, MongoDB, a document-oriented NoSQL database, provides superior flexibility, horizontal scalability, and efficiency in handling semi-structured and unstructured data, which is vital for dynamic use cases like forums, social networks, and IoT platforms. Various considerations, including data type, scalability needs, transaction integrity, cost, and connection with current systems, influence SMEs' decisions between the two. MySQL ensures stability and consistency in transactional contexts, whereas MongoDB enables innovation in rapidly evolving, data-driven environments. Together, they represent complementary tools rather than competitors, allowing SMEs to align database selection with business priorities. A careful evaluation of long-term goals can guide SMEs in adopting the most effective database strategy.

Future research may explore hybrid architectures that combine relational and non-relational features, supporting both structured and unstructured data in unified systems. The rise of NewSQL databases, which merge NoSQL scalability with SQL's transactional guarantees, offers a promising direction. Additionally, with increasing reliance on cloud-native applications, further work should assess the cost, performance, and security trade-offs of deploying MySQL and MongoDB in managed cloud environments.

8. References

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