POLİTEKNİK DERGİSİ

JOURNAL of POLYTECHNIC

ISSN: 1302-0900 (PRINT), ISSN: 2147-9429 (ONLINE)
URL: http://dergipark.org.tr/politeknik

Data storage and management system using spider web structure: A new model

Örümcek ağı yapısını kullanarak veri depolama ve işletme yönetimi sistemi: Yeni bir model

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To cite to this article: Yazıcı A. M. and Çiçeklioğlu H., "Data Storage and Management System Using Spider Web Structure: A New Model", ***Journal of Polytechnic***, 29(2):290215:1-10 (2026).

Bu makaleye şu şekilde atıfta bulunabilirsiniz: Yazıcı A. M. ve Çiçeklioğlu H., "Data Storage and Management System Using Spider Web Structure: A New Model", ***Politeknik Dergisi***, 29(2):290215:1-10 (2026).

Erişim linki (To link to this article): http://dergipark.org.tr/politeknik/archive

DOI: 10.2339/politeknik.1591401

Data Storage and Management System Using Spider Web Structure: A New Model

Highlights

- *Inspired by the durability and organizational efficiency of spider webs in nature, the system uses a decentralized and distributed structure to optimize data management, storage, and processing.*
- *A clear migration map shows the data movement between the central control node and peripheral storage/processing nodes, providing transparent data flow and traceable routes.*
- *The system eliminates single-point failures through multiple redundant routes, providing a secure and flexible alternative to traditional centralized systems.*
- *The system increases overall system performance and efficiency by dynamically balancing workloads among nodes according to data density.*

Graphical Abstract

This study proposes a distributed system that optimizes data storage and processing processes by taking inspiration from the spider web structure.

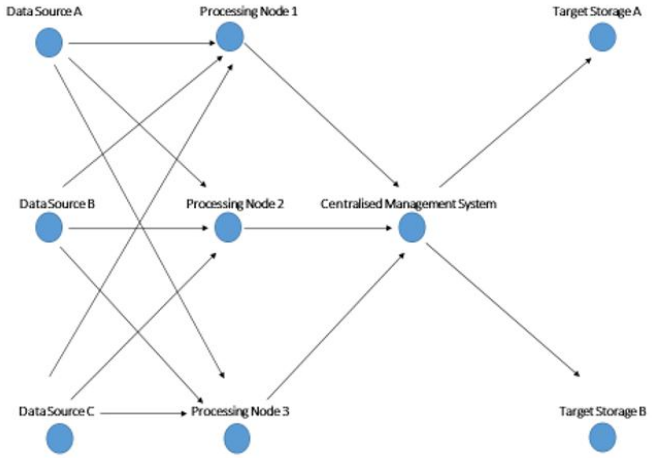

Figure. Data migration map

Aim

This work aims to design a spider web-inspired system to optimize the management, storage, and processing of data.

Design & Methodology

The system employs a spider web-inspired architecture with a central node managing data flow to peripheral storage and processing units.

Originality

The innovative approach of the system lies in its decentralized architecture inspired by the flexibility and resilience of spider webs.

Findings

The spider web-inspired system successfully improves data security and can prevent loss through redundant paths.

Conclusion

The developed system provides a robust, scalable, and durable solution for modern data management challenges.

Declaration of Ethical Standards

The author of this article declare that the materials and methods used in this study do not require ethical committee permission and/or legal-special permission.

Data Storage and Management System Using Spider Web Structure: A New Model

Araştırma Makalesi / Research Article

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(Geliş/Received : 26.11.2024 ; Kabul/Accepted : 09.02.2025 ; Erken Görünüm/Early View: 18.08.2025)

ABSTRACT

This model is a system that optimises the management, storage and processing of data, inspired by the structural resilience and organisational distribution of the spider web in nature. This system has a decentralised, distributed structure, connecting data storage points and processing centres through spider web-like nodes and links. The migration map, represented by arrows from a central control node to different storage and processing nodes, describes how data moves through the system and the routes it takes. The main purpose of this system is to provide secure, fast and flexible management of data storage and processing processes. The central control unit, like a node at the centre of the spider web, supervises the system and ensures that the data is directed to the correct destinations, while the peripheral nodes act as data storage and processing centres. By establishing flexible connections between these structures, a redundancy mechanism has been created against data loss and failures. Thanks to the migration map, it can be clearly seen which storage or processing unit the data has been moved to and which paths it has travelled. The innovative aspect of this system is that it is based on the flexibility and security of the distributed structure.

Keywords: Distributed data storage, spider web structure, data migration system, decentralized management, redundant data pathways.

Örümcek Ağı Yapısını Kullanarak Veri Depolama ve İşletme Yönetimi Sistemi: Yeni Bir Model

ÖZ

Bu model, doğadaki örümcek ağının yapısal dayanıklılığından ve örgütsel dağılımından esinlenerek verilerin yönetimini, depolanmasını ve işlenmesini optimize eden bir sistemdir. Bu sistem, veri depolama noktalarını ve işleme merkezlerini örümcek ağı benzeri düğümler ve bağlantılar aracılığıyla birbirine bağlayan merkezi olmayan, dağıtılmış bir yapıya sahiptir. Merkezi bir kontrol düğümünden farklı depolama ve işleme düğümlerine oklarla gösterilen göç haritası, verilerin sistem içinde nasıl hareket ettiğini ve hangi rotaları izlediğini açıklamaktadır. Bu sistemin temel amacı, veri depolama ve işleme süreçlerinin güvenli, hızlı ve esnek bir şekilde yönetilmesini sağlamaktır. Örümcek ağının merkezindeki bir düğüm gibi olan merkezi kontrol ünitesi, sistemi denetler ve verilerin doğru hedeflere yönlendirilmesini sağlarken, çevresel düğümler veri depolama ve işleme merkezleri olarak işlev görür. Bu yapılar arasında esnek bağlantılar kurularak, veri kaybına ve arızalara karşı bir yedeklilik mekanizması oluşturulmuştur. Göç haritası sayesinde, verilerin hangi depolama veya işleme birimine taşındığı ve hangi yolları izlediği açıkça görülebilir. Bu sistemin yenilikçi yönü, dağıtılmış yapının esnekliğine ve güvenliğine dayanmasıdır.

Anahtar Kelimeler: Dağıtık veri depolama, örümcek ağı yapısı, veri taşıma sistemi, merkezi olmayan yönetim, yedekli veri yolları.

1. INTRODUCTION

Today, fast, secure and efficient management of data is crucial for business and technological infrastructures. Traditional centralised data storage and management systems face various challenges such as data security, performance degradation and single points of failure. In this context, systems inspired by patterns and organisational structures in nature offer new solutions for distributed data management. The spider web structure is known for its ability to organise flexible, robust and complex data flows in nature. In this paper, a distributed data storage and enterprise management system inspired by the spider web structure is introduced. The complex and flexible structure of the spider web in nature, combined with the decentralised management approach, enables the creation of a more robust and scalable data management infrastructure.

The aim of this study is to investigate how the spider web structure can be applied to data storage and management processes based on Network Theory and Distributed Systems Theory. Network Theory is particularly used in the management and optimisation of complex systems [1], [2]. This theory focuses on distributed structures that allow each node in the network to flexibly interconnect and exchange information without being dependent on a centralised structure. Distributed systems aim to create a secure and scalable structure by storing data in different units without uploading it to a centralised unit [3].

In this study, in the light of distributed systems and network theory, answers to the following questions are sought:

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RQ1: What is the applicability of spider web structure to distributed data storage and management processes in the context of network theory? This question seeks to understand how the spider web structure moves and processes data between nodes.

RQ2: How can data migration and security be optimised by blending distributed systems theory with spider web structure? This addresses how data can be securely transported and processed within the system without depending on a central point.

RQ3: How does this structure provide an advantage in terms of performance and security compared to traditional data storage and management systems? This question compares performance parameters such as system resilience and speed.

Existing data storage and enterprise management systems suffer from various limitations in effectively managing large data streams [4]. The fact that centralised structures create weak points in data security and bottlenecks that reduce system performance reveals the necessity of alternative and more flexible solutions [5]. At this point, the integration of the spider web structure into data management processes inspired by nature constitutes an important gap in the literature. The distributed and flexible structure of the spider web structure offers a new perspective for the secure transport, storage and processing of data. This paper aims to fill this gap and present a more secure, resilient and performance-oriented data management system design.

While the existing literature has addressed in detail the performance and security weaknesses of centralised systems for data management [6], [7], research on nature-inspired distributed data systems is limited. In particular, the flexible and robust nature of the spider web structure and its utilisation in data storage processes has hardly been addressed in the literature. This study aims to fill this gap and present an innovative approach in data storage systems. Thanks to the resilience of the spider web structure, data flow between nodes is optimised, data loss and system failures are minimised. This is an important innovation from both theoretical and practical perspectives.

In this context, as an extension of the research on the importance of distributed and redundant structures in data management [8], a more powerful and efficient system is proposed with the spider web model. The theoretical foundation of the system aims to contribute to future distributed system studies by bringing a nature-inspired perspective to data management processes.

This model provides an important solution for many industries and sectors that need to store, process and manage big data. In particular, it is designed to be used in areas where large-scale data sets need to be managed effectively, such as cloud computing, industrial business management, telecommunications, financial services and healthcare. The system is optimised to meet complex data storage and business management needs by leveraging the flexibility, scalability and resilience of the spider web structure. In this way, it offers cost savings and competitive advantage to its users by providing significant advantages such as fast access to data, secure storage, data integrity and optimisation of business processes.

2. BASIC OF SPIDER WEB STRUCTURE

Spider web structures are known to form complex and durable webs in nature [9]. Spiders weave different web structures to capture prey and protect themselves from external threats. These webs are constructed with unique geometric layouts (Fig. 1.) that provide both flexibility and durability [10]. Spider webs have an organisational structure consisting of knots and strands. These nodes perform interconnected functions to move information or data from one point to another in the system [11]. These structural features are noteworthy for their applicability to data storage and management processes.

When looking at the structures of spider webs in nature, two main features, flexibility and durability, stand out. While flexibility refers to the ability of the web to maintain its own structure against external interventions or breaks, resilience enables the web to survive for a long time against various external threats [12]. These structures also offer significant advantages in terms of adapting to the ever-changing needs of data systems. These flexible and resilient structures in nature can be a source of inspiration for optimising data storage processes. In data management, the geometric structure of the spider web can be used to develop decentralised systems. Each node represents data storage units, while the connections between nodes enable data flow. This structure makes it possible to securely transmit data from one point to another, while at the same time minimising data loss. Therefore, the spider web structure provides a suitable model for adapting its durability and flexibility in nature to data management systems.

2.1. Spider Web Patterns in Nature

Spider web patterns appear in many different forms in nature. The most common are circular (orb-web) and tangled-web structures (Fig. 2.) [12]. Circular networks are constructed as symmetric rings radiating from a regular centre. This model provides regularity and convenience in data flow and can be applied to data management systems that revolve around a central node. Circular structures often facilitate the organised storage of large chunks of data and their access from different points [13]. Complex spider web models, on the other hand, contain irregular and asymmetric structures. These models can be used in situations where the data flow is more chaotic and irregular data flows need to be managed more efficiently [14]. Complex network structures can be more effective in big data systems where data traffic is more unpredictable. This irregularity allows for more flexible connections between the data source and data destinations, which allows the data flow to continue in case of damage to part of the network [15].

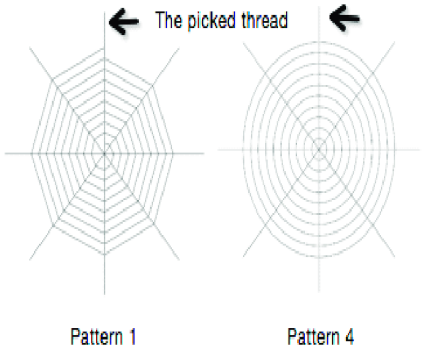

Figure 1. Circular (orb-web) (right) and tangled (tangled-web) (left) structure of the spider web
Source: [12]. Permission for the image has been obtained.

These spider web models in nature offer flexible solutions according to different needs in data management. Centralised and circular structures are ideal for more static and organised data storage processes, while complex and irregular models are suitable for managing large and constantly changing data streams. Which network model to use in data management processes may vary according to the needs of data systems.

2.2. Application of Spider Web Structure to Data Storage

The application of the spider web structure to data storage processes offers a new perspective, especially for distributed data management. The nodes of the network structure can be considered as data storage points. The connections between these nodes symbolise how data is moved from one point to another. The spider web model provides flexibility and scalability in data storage systems. In case of system failures or data loss, the data flow can continue through alternative nodes. The decentralised structure of the network prevents a single point of failure from bringing down the entire system. This structure increases security in data storage processes by eliminating the weaknesses of traditional centralised systems. For example, a failure in one node allows data to flow through other nodes. In this way, risks such as data loss or system crash are minimised. In data migration processes, flexible connections between nodes are established to distribute the data load in a balanced manner.

The spider web structure applied to data storage systems enables the system to operate more efficiently. Inter-node connections minimise the time required for data processing and storage and ensure secure transmission of data. This application increases the functionality of data centres and helps to create higher performance and security.

2.3. Advantages of Spider Web Approach in Data Management

One of the biggest advantages of the spider web approach to data management is flexibility and scalability. In traditional centralised data storage systems, the collection of data in a specific centre can compromise the performance and security of the network. The spider web structure eliminates these risks by directing the flow of data between distributed nodes. This flexibility allows the network to maintain its performance in case of increased data density, especially in big data management systems. Another advantage is the resilience of the system. Thanks to its decentralised structure, data flow can continue uninterrupted even if part of the network fails. Connections between nodes create redundant data paths, enabling data flow through alternative paths in case of data loss or system crash. This structure increases data security and system continuity, making processes that are important for business continuity uninterrupted. Finally, this approach also offers significant advantages in terms of cost effectiveness. Centralised systems are usually costly to maintain and update. In the spider web structure, on the other hand, it is possible to use resources more effectively thanks to the distributed and flexible structure of the system. This enables data management processes to be managed at a lower cost in the long term.

2.4. Data Storage and Business Management

Data storage is an important element in the modern business world [16]. Businesses have to store large chunks of data in a secure and accessible way. While traditional data storage methods involve the use of physical servers, cloud-based solutions are becoming widespread today [17]. By storing their data quickly and reliably, businesses can both increase their operational efficiency and minimise the risks of data loss. In addition, data management processes support companies' strategic decision-making processes and contribute to optimising business processes [18]. The development of data storage systems has also had a direct impact on business management. Businesses not only store data, but also make strategic decisions by analysing this data. In this context, effective management of data increases business performance and competitive advantage [19]. Therefore, businesses can manage their business processes more effectively by choosing the right data storage solutions.

Innovative solutions such as spider web-based data storage systems make these processes more flexible and scalable. This relationship between data storage and business management has been further deepened by technological innovations and digitalisation. While traditional systems have limited scalability and flexibility issues, spider web-based solutions have started a new era in data management with their decentralised structure. Therefore, business management should adapt to digitalisation processes in line with the development of data storage systems.

2.5. Traditional Data Storage Methods

Traditional data storage methods usually involve storing data on physical servers and hard discs. Although this method initially provided businesses with high data security, it has become disadvantageous today due to scalability and maintenance difficulties [20]. While physical servers provide secure storage of data, they

carry the risk of data loss in cases such as hardware failures or natural disasters. In addition, the installation and maintenance of these systems are associated with high costs [21].

Another disadvantage of these systems is the limitations arising from their centralised structure. In centralised data storage systems, all data are collected and processed in a specific centre. This may cause data traffic to intensify and bottlenecks to occur in the system. In addition, if centralised systems crash, all data processing processes may stop, which can lead to serious disruptions in business operations [22]. Traditional data storage methods cannot provide sufficient flexibility in today's fast and dynamic business world. Businesses are looking for alternative solutions to manage the growing amount of data and optimise data processing. Spider web-based data storage systems aim to eliminate the limitations of traditional methods by providing a more effective solution at this point.

2.6. Features of Spider Web Based Data Storage Systems

Spider web-based data storage systems have been developed as an alternative to traditional data storage systems by offering a decentralized structure. These systems establish connections that provide data flow between nodes, allowing data to be stored in a distributed manner. In the spider web model, each node acts as a data storage point, and flexible data transitions are made between each node in the network. This structure minimizes the risk of data loss and security vulnerabilities. For example, when a node fails, data can continue to be provided from other nodes. One of the biggest advantages of this system is that it is scalable. As the size of the data increases, new nodes can be added to expand the system capacity. While scalability is limited in traditional centralized systems, this problem is minimized in spider web-based systems. In addition, thanks to the optimization of data transitions between nodes, data access times are also shortened, which speeds up data processing processes for businesses. This structure also provides a cost advantage. While maintenance and update costs can be high in centralized systems, these costs are lower in distributed systems. In addition, thanks to the flexible structure of the system in data storage and processing processes, businesses have a structure that can be easily scaled according to their needs. This increases business efficiency and contributes to reducing costs in the long term.

2.7. Data Processing Techniques in Business Management

Data processing techniques are one of the most important elements that support the decision-making processes of businesses. Data analytics allows businesses to make predictions about the future based on past data. This process is optimized with the use of data mining, big data analysis, and artificial intelligence algorithms [23]. The most common data processing techniques used in business management are real-time data analysis and machine learning algorithms. Real-time analysis gives businesses the ability to make instant decisions. For example, an e-commerce platform can instantly monitor user behavior and offer personalized product recommendations [24]. Machine learning algorithms, on the other hand, provide businesses with better decision-making processes by working on large data sets [25]. The correct application of data processing techniques in business management increases competitive advantage. By effectively processing their data, businesses can both reduce their operational costs and make strategic decision-making processes more efficient. Effective use of data processing techniques accelerates the digitalization processes of businesses, increases their innovation capacity and enables them to achieve long-term success [26].

3. SPIDER WEB STRUCTURE DATA STORAGE SYSTEM DESIGN MODEL

Figure 2 presents the design model of the invention. The system in this model focuses on the following elements:

Spider Web Structure: The system is based on a spider web structure. This structure creates a distributed storage and communication network. Each node has data storage and processing capabilities and can communicate with other nodes.

Data Storage and Processing Units: Each spider node has hardware and software components to store and process data. These units can segment, store, and process data.

Distributed Storage: Data is stored by distributing it across various nodes in the spider web structure. This increases the speed of access to data, balances the load and increases reliability in the system.

Business Management and Coordination: The system uses specialised algorithms and software to coordinate the data storage, processing and communication processes. This optimises access to data and helps to balance the processing load and improves system performance.

This figure visually expresses the working principle of the data storage and enterprise management system using the spider web structure. This principle provides flexibility, scalability and reliability in data management by providing distributed storage, processing and communication.

Data Sources: Several different points representing various data sources.

Data Processing Nodes: Nodes representing the spider web structure.

Central Management System: A centralised unit that manages the data coming from the data processing nodes.

Target Storage Areas: The places where the resulting data is stored.

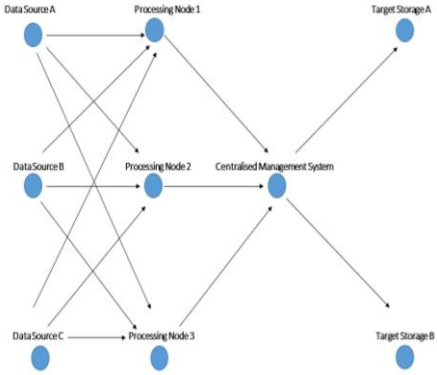

Figure 2. Data migration map
Source: (Authors's own design)

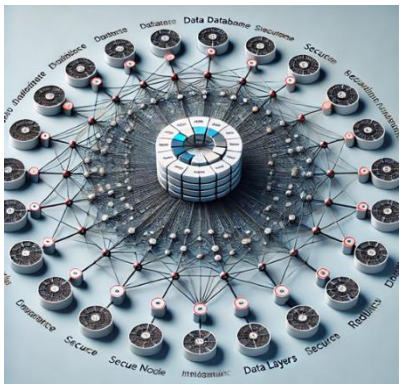

Figure 3. Conceptual diagram of the model
Source: (Authors's own design)

The structure we propose is as follows:
Data sources send data to data processing nodes.
Data processing nodes process the data and forward it to the central management system.
The central management system routes the data to the destination storage areas.
Data Sources (Data Source A, Data Source B, Data Source C) are located on the left side. Data Processing Nodes (Processing Node 1, Processing Node 2, Processing Node 3) are located in the centre and receive data from the data sources. The Central Management System manages the data from the data processing nodes and is located to the right of the centre. The Target Storage Areas (Target Storage A, Target Storage B) are located on the right side and store data from the central management system.
The conceptual diagram of the model in Figure 3 depicts an innovative data storage and management system based on the spider web structure. This conceptual diagram is described step by step below:

Centre Hub (Master Database):
The centre of the spider web represents the main database of the system. This point is the starting point of the data and acts as the centre of all data processing and storage operations. The system manages the entire data flow from here.

Radial Lines (Data Transit Channels):
The radial lines in the spider web structure symbolise the data passage channels extending from the centre to the outer layers. These channels perform data transfer and migration. It provides fast and secure data flow between different data nodes.

Spiral Threads (Data Layers and Security):
Spiral threads surrounding radial lines indicate different layers and security levels in the data storage system. These layers ensure that data is securely protected and backed up when necessary. Data requiring high security is protected in the inner layers.

Data Nodes:
Data nodes, located in different parts of the network, represent various storage points. These points symbolise system components where data is stored and processed in a distributed manner. Inter-node connections provide data redundancy and accelerated access.

Flexibility and Scalability:
Inspired by the nature of the spider web structure, this system is highly flexible and scalable. Adding new data nodes or expanding the existing structure can be realised without compromising the integrity of the system. This flexibility allows the system to adapt to increasing data volumes.

Redirection and Redundancy:
As in the spider web structure, when an error occurs in any data node or transit channel, the system has the capacity to redirect the data through an alternative path. This feature minimises the risk of data loss and increases the resilience of the system.
This model provides efficient, secure and optimised management of data flow, while at the same time having the robustness of a natural network structure.
A list of the elements of the invention in order of importance is shown in Table 1.

Table 1. Elements of the invention and their importance

Element No	Element Name	New	Previous Technique	Very important for the invention	Function of the Element
1	Central Management System	Yes	No	Yes	It provides a central point to control and direct data flow.
2	Data Source	Yes	No	Yes	It provides the main data flow, ensures fast and effective transmission of data.
3	Data Source	Yes	No	Yes	It increases the flexibility and scalability of the system by distributing the data flow to various points.
4	Target Storage	Yes	No	Yes	It ensures secure storage of data, optimizes its accessibility and performance.
5	Processing Node	Yes	No	Yes	It enables data processing, analysis, reporting and management of workflows.

4. APPLICATION OF SPIDER WEB STRUCTURE IN BUSINESS MANAGEMENT

The integration of the spider web structure into business management provides a major transformation in the data management processes of enterprises. This structure offers a more effective solution compared to traditional methods by providing decentralised and flexible data management processes. Especially in today's business world, where issues such as big data and data analytics are at the forefront, the spider web structure can offer significant advantages to businesses such as flexibility, scalability and data security. While this structure enables businesses to adapt to rapid changes, it also provides optimisation in data processing processes. Another advantage of the spider web structure is that it is more resistant to possible system failures due to the dispersed data source. A decentralised structure ensures that a failure at any point does not affect other data points. In this way, businesses can continue their operational processes with minimum interruption. At the same time, data flow becomes faster and more reliable. The use of such innovative approaches in business management accelerates strategic decision-making processes. One of the biggest benefits offered by the spider web structure to businesses is the cost advantage. This structure, which requires less maintenance and updates than centralised systems, saves businesses in the long run. Thanks to distributed data structures, businesses can achieve the same efficiency with less hardware requirements. This structure offers significant cost advantages to businesses, especially in large-scale data management.

4.1. Data Management and Optimization

Data management is one of the most important functions of businesses. Spider web-based systems optimise this process with decentralised data storage and processing capabilities. While in traditional centralised systems, data is collected at a specific point, the spider web structure distributes data across many nodes. This allows data to be managed more securely and quickly. At the same time, the distributed structure of the data minimises the risk of data loss and increases the resilience of the system. This structure gives businesses a significant advantage in the processes of managing and analysing large data sets. Data optimisation is essential for businesses to make their operational processes more efficient. Spider web-based systems allow data to be processed and analysed faster. Optimised management of data between distributed nodes accelerates data flow and reduces access times to information. Especially in areas such as big data and data analytics, these systems help businesses make more effective decisions. This structure also provides cost optimisation. Hardware and maintenance costs encountered in centralised systems are minimised with distributed structures. Spider web-based systems offer businesses more efficiency with less hardware. This helps businesses to keep their costs under control in their growth processes and provides financial advantages in the long term.

4.2. Effectiveness of Spider Web Based Models

Spider web based models stand out in business management by providing efficiency in data storage and processing processes. These models minimise problems such as data loss and access time by enabling distributed storage and processing of data. These models, which provide flexibility and speed in data flow thanks to their decentralised structure, offer a great advantage especially in big data management. In addition, the system prevents the interruption of business processes by ensuring that the data flow continues in the event of a possible node failure. The effectiveness of these models also manifests itself in the processing of business data. Especially fast and accurate data processing processes support the strategic decisions of businesses. Analysing data quickly and presenting it to decision makers provides competitive advantage. In this context, spider web-based models minimise delays in data processing processes and provide operational efficiency to businesses. These models are also optimised for big data analytics and artificial intelligence applications. Finally, integrating these models into business management is also important in terms of cost efficiency. Costly hardware and software maintenance processes experienced in centralised systems are minimised with distributed structures. Spider web-based systems help businesses to use their budgets more effectively by offering high performance at low cost. This efficiency contributes to the adoption of more strategic and flexible approaches in business management.

4.3. Case Study

In order to understand how spider web-based data storage systems are applied in business management, it would be useful to make a case study. For example, Amazon, an e-commerce platform, uses distributed data storage systems in data management processes. Amazon's adoption of this structure has enabled it to process large amounts of customer data safely and quickly. Thanks to spider web-like structures, personalised services based on user behaviour are offered and data are securely stored on servers in different parts of the world [27]. This decentralised structure provides great speed and efficiency in Amazon's operational processes. For example, as soon as users enter the site, recommendation engines instantly analyse the data and provide personalised recommendations. In this process, the data is quickly processed between different nodes and the most appropriate results are presented to the customer. Large-scale companies such as Amazon provide competitive advantage by increasing customer satisfaction with such systems [28]. In addition, this structure provides uninterrupted service by preventing possible server failures from disrupting operations

This kind of structure can be similarly applied in other sectors. For example, in the healthcare sector, large amounts of patient data need to be managed and securely stored. Spider web-based data storage systems can improve the quality of healthcare services by enabling

fast and secure sharing of patient data between different healthcare facilities. These examples show how effective and useful distributed data systems are in business management [29].

5. TECHNOLOGICAL INFRASTRUCTURE AND DEVELOPMENT PROCESS

5.1. System Design

System design is a process that determines the basic structure and functioning of a technological system. This stage consists of creating the architecture of the system, analysing the requirements and defining the functional components. In system design, factors such as how the system will respond to user needs and which technological components will be integrated are taken into account. This stage determines the basic building blocks that directly affect the success of the system [30]. With advancing technology, system design is becoming more complex. Modern system design aims to adapt to changing needs and technology by focusing on concepts such as flexibility and scalability [31]. In this context, the functioning of the system is optimised by considering user experience and performance requirements. System design also encompasses important issues such as integration and compatibility, thus requiring meticulous planning to determine how different components will work together [32]. An effective system design relies on the successful implementation of the technological infrastructure.

This process requires careful analysis and planning to ensure the long-term success of the system [33]. Decisions made during the design phase directly affect the performance, reliability and user satisfaction of the system, so this phase needs to be intensively studied.

5.2. Software Architecture

Software architecture is a plan that determines the structure of the software system and how its components will interact. This phase ensures the modularity, flexibility and maintainability of the system [34]. Software architecture design usually adopts a layered approach and defines the relationships between these layers. This approach facilitates the management and extension of software [35]. Software architecture also considers important factors such as performance and reliability, so each component needs to be optimised.

There are various models and patterns used in software architecture design. For example, different approaches such as microservice architecture and monolithic architecture can be chosen according to the needs of the system [36]. Microservice architecture allows the system to be composed of small, independent components, which increases scalability and flexibility. On the other hand, monolithic architecture offers a simpler structure but has limitations on scalability [37]. Software architecture is one of the cornerstones of the software development process and affects the overall success of the system. A good software architecture improves system maintainability, performance and user experience, and therefore requires careful planning and design [38]. Software architecture should be continuously updated to adapt to changing technology and user needs.

5.3. Security and Data Integrity

Security and data integrity are essential for the protection of modern systems. Security ensures that the system is protected against unauthorised access, data leaks and other threats [39]. In this context, various security measures such as encryption, authentication and access control are implemented. In addition, data integrity ensures that the data in the system is accurate, reliable, and unaltered [40]. In addition to security measures, various techniques and methods are used to ensure data integrity. These methods include data backup, error detection, and data validation [41]. These techniques help to prevent data loss and minimise potential errors in the system. In addition, continuous monitoring and regular security updates are required for data integrity [42]. Security and data integrity are essential elements to ensure the reliability of a system and user trust. The steps taken in these areas directly affect the long-term success of the system and user satisfaction [43]. Paying attention to security and data integrity at every stage of technological infrastructure increases the security and efficiency of the system.

6. COMMERCIAL POTENTIAL OF SPIDER WEB BASED DATA STORAGE SYSTEM

6.1. Market Analysis and Competition

Spider web-based data storage systems offer an innovative approach to data management, thus revealing a remarkable potential in market analysis. Such systems have an important place in the big data and cloud computing markets, offering advantages such as high data access speeds and scalability. However, this market is highly competitive and many traditional data storage solutions have been known for their reliability for many years. In particular, the dominance of major players such as Amazon Web Services (AWS) and Microsoft Azure can make it difficult for new technologies to enter the market.

Competitive analysis is important to determine how much the innovative features offered by spider web-based systems stand out compared to traditional data storage solutions. The unique network structure of these systems can provide cost savings by optimising data processing and storage processes, making them an attractive alternative. However, the saturation of the existing market and customer loyalty are important factors influencing the adoption of new technologies. The market potential of cobweb-based data storage systems offers a significant opportunity depending on their innovative approach and competitive advantages. However, in order to realise this potential, it is necessary to carefully analyse the dynamics of the market and the existing competition and develop strategies accordingly.

6.2. Market Analysis and Competition

Technological collaborations are essential for the commercial success of cobweb-based data storage systems. Such collaborations can enable the development of new technologies and the improvement of existing systems. Collaborations with technology companies, universities and research organisations offer a great advantage in terms of developing innovative solutions and improving the performance of systems [44]. Furthermore, these collaborations can accelerate the testing and commercialisation of new technologies. Venture potential is another important factor that determines how successful spider web-based systems can be in the commercial field. The presence of these technologies in the entrepreneurial ecosystem offers various opportunities in terms of finding financing and market access [45]. Start-up companies and technology entrepreneurs can play an important role in developing and launching innovative data storage solutions. Such initiatives can attract the attention of investors and offer solutions that fit the needs of the market [46]. Strong technological collaborations and entrepreneurial strategies should be developed to maximise the commercial potential of spider web-based data storage systems. In this process, collaborations and venture opportunities are of great importance to emphasise the innovative features of the systems and to respond to the demands of the market.

6.3. Commercialisation Strategies

Commercialisation strategies are important for the successful launch of spider web-based data storage systems. Firstly, it is necessary to identify the target market and develop an effective marketing strategy in this market [47]. This includes a promotional process that emphasises the advantages of the product and attracts the attention of potential customers. It is also important to create pricing and distribution strategies that are appropriate to the needs of the market [48]. Secondly, improvements should be made based on product development and user feedback. Customer feedback plays an important role in determining whether the product is in line with market demands, and the features and performance of the product can be improved in line with this feedback [49]. Furthermore, in the commercialisation process, supporting the product with additional services such as technical support and customer service can increase user satisfaction and provide a competitive advantage [50]. Commercialisation of spider web-based data storage systems can be successfully achieved through effective marketing, continuous product improvement and strong customer support strategies. These strategies can ensure a firm foothold for the product in the market and long-term commercial success.

7. CONCLUSION AND RECOMMENDATIONS

7.1. Conclusion

The model in this paper is a system that optimises the management, storage and processing of data, inspired by the structural robustness and organisational distribution of the spider web in nature. Spider web-based data storage systems offer significant advantages over existing data management solutions. These are that the spider web structure provides high performance and scalability by optimising data storage and access processes, and the network structure of these systems increases data integrity and access speeds. These advantages show that cobweb-based systems offer an effective alternative, especially in the fields of big data and cloud computing. It has also demonstrated how cobweb-based data storage systems can overcome some of the current limitations encountered in data management. These systems offer lower costs and greater flexibility than traditional data storage solutions. In addition, the modular nature of the systems enables data management processes to be carried out more efficiently. These support the fact that cobweb-based systems offer distinct advantages compared to existing solutions in the industry. These advantages provide a strong basis for assessing the future potential of the systems and increasing their application in the industry.

7.2. Spider Web Structure and the Future of Data Storage

The implications of the spider web structure on data storage play an important role in the future of technology. This structure can make data access and management more efficient and accelerate the processing of large data sets. These advantages can ensure that cobweb-based systems will gain an important place among data storage solutions in the future. In the future, the spider web structure is expected to find more space in data storage technologies and can be used in more advanced application scenarios. The integration of these systems with advanced technologies such as artificial intelligence and machine learning can provide even greater innovations in data management. In addition, these integrations may allow systems to become more intelligent and adaptive. The impact of spider web structure on data storage is emerging as an important trend in the future of technology. The integration of these structures with a wider range of applications and advanced technologies could shape the future evolution of data storage solutions and drive innovations in the industry.

7.3. Suggestions for Future Research

Future research requires a more comprehensive and detailed investigation of cobweb-based data storage systems. In particular, it is important to evaluate the performance of the systems in different data types and application scenarios. Such research is important to determine how the systems respond to various use cases and how efficient they are in these situations. Another recommendation is to investigate spider web-based

systems in more detail in terms of security and data integrity. The effectiveness of security protocols and data protection methods is of paramount importance for the widespread adoption of these systems. Future research should provide a comprehensive assessment of these systems with the aim of identifying and improving their security vulnerabilities and data protection strategies, and should delve deeper into the performance, security, and application potential of cobweb-based data storage systems. This research will provide important information to support wider adoption of the systems and the development of the technology.

DECLARATION OF ETHICAL STANDARDS

The authors of this article declare that the materials and methods they used in their studies do not require ethics committee approval and/or legal-specific permission.

AUTHORS' CONTRIBUTIONS

Ayşe Meriç Yazıcı: Contributed to the theoretical framework and data modeling.

Hüseyin Çiçeklioğlu: Contributed to the system architecture and practical application insights.

CONFLICT OF INTEREST

There is no conflict of interest in this study.

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