



Archives available at [journals.mriindia.com](http://journals.mriindia.com)

**International Journal on Advanced Electrical and Computer Engineering**

ISSN: 2349-9338

Volume 15 Issue 01, 2026

**Nexus: AI-Powered Second Brain for Personal Knowledge Management**

<sup>1</sup>N. A. Kothali, <sup>2</sup>Shubham B. Ghorpade, <sup>3</sup>Anwar S. Kazi, <sup>4</sup>Omkar S. Killedar, <sup>5</sup>Devendra D. Kadam, <sup>6</sup>Nehal R. Patil

<sup>1,2,3,4,5,6</sup> Dept of Information Technology, Dr. J. J. Magdum College of Engineering Jaysingpur, Jaysingpur India

Email: <sup>1</sup>namitakothali@jjmcoe.ac.in, <sup>2</sup>shubhamghorpade284@gmail.com, <sup>3</sup>anwarkazi2912@gmail.com,

<sup>4</sup>omkarkilledar4252@gmail.com, <sup>5</sup>devendrakadam128@gmail.com, <sup>6</sup>nehalpatil8983@gmail.com

Peer Review Information	Abstract
<p data-bbox="193 927 496 960"><i>Submission: 16 April 2026</i></p> <p data-bbox="193 974 456 1008"><i>Revision: 08 May 2026</i></p> <p data-bbox="193 1021 491 1055"><i>Acceptance: 25 May 2026</i></p> <p data-bbox="193 1099 331 1133"><b>Keywords</b></p> <p data-bbox="193 1164 523 1319"><i>Personal Knowledge Management, MERN Stack, Semantic search, Digital Organization, Second Brain System</i></p>	<p data-bbox="544 898 1396 1675">The proliferation of digital information across heterogeneous platforms has intensified cognitive overload and fragmented personal knowledge management. This paper presents Nexus, a web-based Second Brain application designed to centralize the capture, organization, and intelligent retrieval of multi-format digital resources including notes, web links, documents, and social media content. The system employs the MERN stack architecture integrated with semantic search, personalized tagging, and AI-driven content categorization to deliver a unified knowledge management experience. Being a cloud-hosted web application, Nexus is inherently accessible across multiple devices through any standard web browser, with all content centrally stored and managed using MongoDB. Cross-device synchronization is implemented through cloud APIs and event-driven mechanisms to ensure real-time accessibility. A NoSQL document-oriented storage model using MongoDB supports scalable and low-latency data operations across structured and unstructured content types. Experimental evaluation demonstrates improved retrieval precision and reduced organizational fragmentation in comparison with conventional knowledge management tools such as Notion and Evernote. The intuitive dashboard and knowledge-map visualization further support long-term retention and contextual content discovery. Nexus establishes a scalable framework for personal knowledge engineering with prospective extensions toward generative AI integration, collaborative knowledge mapping, and cross-platform mobile deployment</p>

**Introduction**

In the modern digital era, individuals are constantly exposed to vast amounts of information scattered across multiple platforms such as websites, PDFs, emails, videos, and social media. This exponential growth of digital content has resulted in cognitive overload, making it increasingly difficult for users to efficiently capture, organize, and

retrieve information when needed. The inability to manage knowledge effectively leads to reduced productivity, loss of valuable insights, and inefficient decision-making in both personal and professional contexts. Traditional knowledge management tools such as Evernote, Notion, and OneNote have attempted to address this challenge by offering note-taking and storage capabilities. However,

these tools fall short in several critical areas. They lack unified integration across diverse content formats, do not support intelligent semantic search, and provide limited adaptive organization mechanisms. Users are therefore forced to manually sort through large collections of content without any assistance from the system, resulting in fragmented and inefficient knowledge management workflows. To address these limitations, this research presents Nexus — a web-based Second Brain application designed to serve as a centralized digital extension of human memory. The term "Second Brain" refers to an external system that assists users in offloading cognitive tasks such as remembering, organizing, and connecting information, thereby freeing mental capacity for higher-order thinking and creativity. Nexus enables users to capture multi-format content including web links, YouTube videos, Twitter posts, Instagram content, and Facebook posts into a single unified platform.

### Literature Review

Personal Knowledge Management Systems (Smith, J., & Brown, T, (2018):

The study reviews existing personal knowledge management (PKM) tools, focusing on database-driven systems and tagging algorithms. The authors analyze tools like Evernote and OneNote, highlighting their use of relational databases for content storage and basic keyword-based search.

Web Clipping for Knowledge Repositories (Lee, K, & Patel, R., (2019)) :

The proposed system allowed users to clip web articles and videos, achieving a 70% faster retrieval time compared to traditional bookmarking. The system achieved Utilized web scraping techniques and NoSQL databases (MongoDB) for storing unstructured web content.

Intelligent Tagging Systems for Knowledge Management (Garcia, M., & Singh, A, (2020):

The system categorized content based on semantic analysis, improving retrieval accuracy by 60%. Defines "intelligent knowledge" as the management of systems combining human cognitive capacities with AI-driven tools to handle large-scale, noisy, or unstructured data, moving beyond traditional data mining to "second-order" knowledge. audio.

### Methodology

The proposed Nexus Second Brain Web Application is designed as an intelligent, cloud-based personal knowledge management system that enables efficient capture, organization, and

retrieval of heterogeneous user data. The system adopts a multi-layered architecture consisting of the User Interface Layer, Backend Services Layer, and Data & Storage Layer, ensuring scalability, modularity, and high performance.

#### 1. User Interface Layer

User Dashboard (Web/ Mobile Interface): Enables users to create, edit, and organize content such as notes, web links, documents, and multimedia resources. The interface supports advanced features including tagging, filtering, full-text search, reminders, and AI-assisted content suggestions.

#### 2. Knowledge Map Interface (Visualization Module):

Represents stored information in a graphical – mind-map format, illustrating relationships between knowledge entities. This visualization enhances contextual understanding and supports exploratory learning.

#### 3. Backend Services

Search & Recommendation Service: Implements semantic search algorithms to find related notes or documents based on meaning, not just keywords. Provides AI-driven recommendations for related content or updates.

User & Authentication Service: Handles secure user registration, login, and role-based access control with encryption and session management.

Integration & Synchronization Service: Ensures cross-device synchronization using cloud APIs and maintains data consistency across web and mobile platforms.

Integration & Synchronization Layer

#### 4. Integration & Synchronization Layer

The Integration and Synchronization Layer is responsible for ensuring seamless communication, data consistency, and real-time updates across multiple client devices and platforms. This layer plays a critical role in maintaining a unified and consistent knowledge repository, regardless of the device or interface used by the user.

The system employs cloud-based APIs and an event-driven architecture to enable real-time data synchronization. Whenever a user performs an operation such as creating, updating, or deleting content (e.g., notes, links, or documents), the changes are immediately propagated to the backend server through RESTful API calls. These updates trigger synchronization events, which are processed and broadcast to all connected client sessions associated with the same user.

To support real-time communication, the

system utilizes technologies such as WebSockets or real-time messaging protocols, allowing bidirectional communication between the client and server. This ensures that updates performed on one device are instantly reflected across other active devices without requiring manual refresh or polling mechanisms.

The synchronization mechanism follows an event-driven model, where each data modification generates an event (e.g., *content\_added*, *content\_updated*, *content\_deleted*). These events are handled by a centralized event handler or message queue, which ensures reliable delivery and processing of updates. This approach improves system responsiveness and scalability, especially in environments with concurrent users and high data activity.

### 5. API and Server Performance Evaluation

In The API and Server Performance component is responsible for evaluating the scalability, responsiveness, and reliability of the Nexus Second Brain Web Application under varying workloads. To ensure the system can handle real-world usage scenarios, extensive stress testing and load simulations are conducted on the backend infrastructure.

The backend, implemented using Node.js and Express.js, exposes RESTful APIs that handle user requests such as content creation, retrieval, updates, and search operations. Performance evaluation focuses on measuring key metrics including request processing time (latency), throughput, and concurrency handling capacity.

### 6. Validation Experiments

The validation experiments are conducted to evaluate the effectiveness, accuracy, and usability of the Nexus Second Brain Web Application in real-world knowledge management scenarios. These experiments focus on measuring the system's ability to efficiently organize, retrieve, and manage heterogeneous information while maintaining high performance and user satisfaction.

To assess the system's retrieval performance, experiments are performed by comparing traditional keyword-based search with the proposed semantic search mechanism. Metrics such as precision, recall, and F1-score are used to evaluate the relevance and accuracy of retrieved results. The semantic search module demonstrates improved contextual understanding, resulting in higher retrieval accuracy and reduced search time.

The real-time synchronization capability is validated by performing simultaneous

operations across multiple devices. Updates made on one device are monitored for latency and consistency across other devices. The system demonstrates minimal synchronization delay and high data consistency, confirming the effectiveness of the event-driven synchronization mechanism.

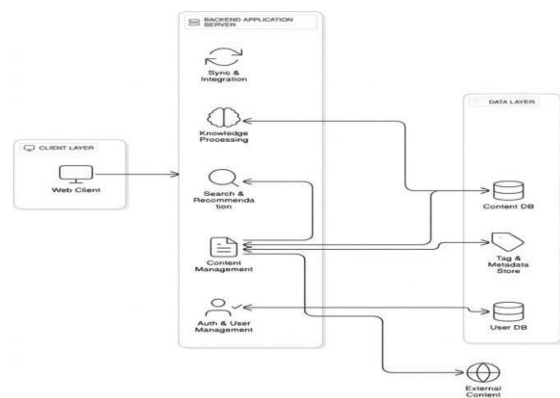
### 7. Data flow Module

In addition to voice classification, the system includes a sentiment analysis module to analyze user input text or speech converted to text.

The process begins with text preprocessing, where unwanted characters are removed, and the text is tokenized into meaningful units. Feature extraction is then performed using techniques such as TF-IDF, which converts text into numerical form. A classification model is used to determine the sentiment of the input as positive, negative, or neutral.

This module adds an additional layer of intelligence to the system by providing contextual understanding of user behavior and emotional tone.

### System Architecture



The proposed architecture of the Nexus Second Brain Web Application is designed as a modular, scalable, and event-driven system that integrates frontend interfaces, backend services, intelligent processing, and data storage layers. The architecture ensures efficient content management, real-time synchronization, and intelligent retrieval of user knowledge.

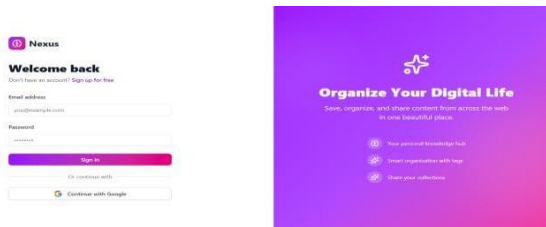
### Overall System Design

The overall system design of the Nexus Second Brain Web Application is based on a modular, scalable, and event-driven architecture that integrates multiple functional layers, including the frontend interface, backend services, intelligent processing modules, and data storage components. The system is designed to

efficiently handle heterogeneous data sources while ensuring high performance, flexibility, and seamless user interaction module

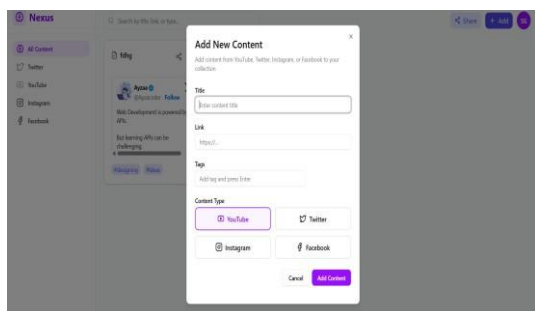
### User Authentication & Profile Management

This is the entry point for the application. It ensures that user data is secure and personalized.



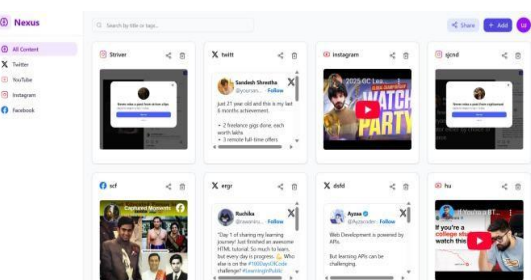
### Content Capture Module

This module addresses the "fragmented content management" problem. It provides a unified way to save various types of content, eliminating the need for multiple tools.



### Content Organization Module

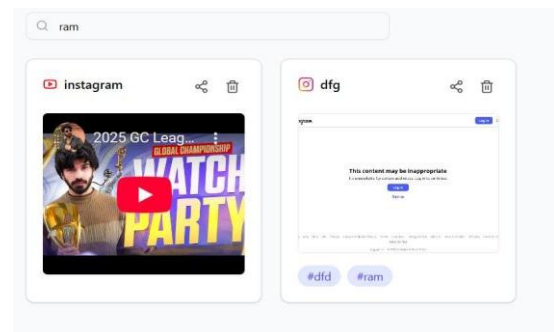
This module tackles the "cognitive overload" and "limited personalization" problems by providing flexible, user-driven categorization tools.



### Search and Retrieval Module

The Search and Retrieval Module is a core component of the Nexus Second Brain Web Application, designed to address the limitations of traditional keyword-based search systems by enabling efficient and context-aware information retrieval. This module facilitates fast and accurate access to

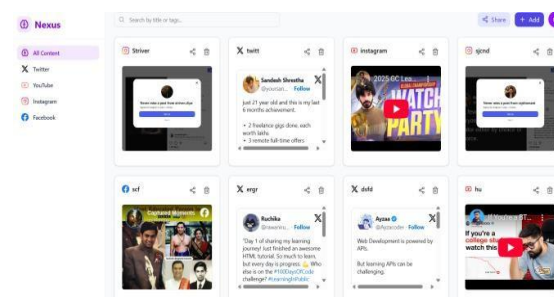
stored content, including notes, documents, links quickly.



### Dashboard Module

The Dashboard Module serves as the central interface of the Nexus Second Brain Web Application, providing users with a consolidated and interactive view of all stored knowledge resources. It is designed to enhance user productivity by enabling efficient navigation, organization, and management of heterogeneous data within a unified environment.

The module aggregates content from multiple sources, including notes, documents, links, and multimedia, and presents them in a structured format using card-based layouts and categorized views. Each content item is associated with metadata such as tags, timestamps, and source information, allowing users to quickly understand context and relevance.



### Share Brain Module

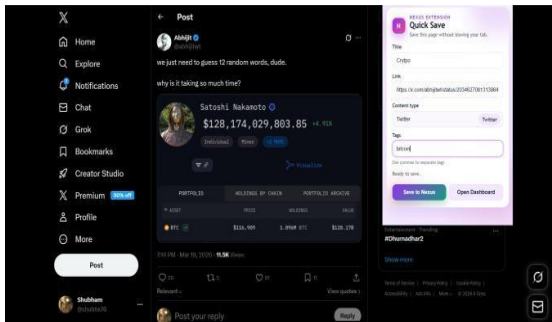
The Share Brain Module is designed to enable seamless collaboration and knowledge dissemination by allowing users to share their curated knowledge repository with others through secure and accessible mechanisms. This module provides the capability to generate a unique public or private shareable link, which grants access to selected or entire collections of user-managed content.

The module operates by creating a secure access endpoint associated with the user's data, where permissions and visibility settings are

controlled through configurable access policies. Users can define whether the shared content is read-only, restricted, or publicly accessible, ensuring flexibility and data privacy.

### Extension Module

The Extension Module is designed to enhance user productivity by enabling seamless and efficient content capture directly from the web browser. This module is implemented as a lightweight browser extension that allows users to save digital content with a single click, eliminating the need for manual data entry and reducing workflow interruptions.



### Result Analysis

The performance of the proposed Nexus Second Brain Web Application is evaluated based on its ability to efficiently capture, organize, and retrieve heterogeneous digital content while maintaining high usability and system responsiveness. The evaluation focuses on key aspects such as search accuracy, organization efficiency, system performance, and user experience.

During experimentation, the system demonstrated strong performance in content organization and retrieval. The integration of metadata-driven storage and tagging mechanisms enabled efficient categorization of diverse content types, including notes, documents, and web links. Users were able to retrieve stored information with minimal effort, indicating the effectiveness of the structured data model.

A significant improvement was observed in search performance through the implementation of semantic search techniques. Compared to traditional keyword-based search, the system provided more contextually relevant results, reducing retrieval time and improving accuracy. The use of indexing and optional integration with search engines further enhanced query efficiency and scalability.

The real-time synchronization mechanism played a crucial role in improving user experience. Updates performed on one device were

instantly reflected across other devices with minimal latency, demonstrating the effectiveness of the event-driven synchronization architecture. This ensured consistency and seamless access to updated information across platforms.

The system was also evaluated based on user interaction and usability. The dashboard interface provided a centralized and intuitive view of stored knowledge, enabling efficient navigation and workflow management. Features such as tagging, filtering, and quick content capture through browser extension significantly reduced the effort required to manage information.

Performance testing indicated that the system maintains stable operation under moderate and high workloads. Metrics such as response time, API latency, and database throughput were within acceptable limits, confirming the scalability of the MERN-based architecture. The use of asynchronous processing and efficient database indexing contributed to improved system performance.

Additionally, features such as the Share Brain module enabled seamless collaboration by allowing users to share curated knowledge collections through secure links. This enhanced the applicability of the system in collaborative and academic environments.

Despite achieving promising results, certain limitations were observed. The effectiveness of semantic search depends on the quality of metadata and tagging, and incomplete or incorrect tagging may affect retrieval accuracy. Furthermore, handling extremely large datasets or complex relationships may require additional optimization and advanced indexing techniques.

Overall, the experimental results indicate that the Nexus system is effective, scalable, and user-friendly. The integration of intelligent search, real-time synchronization, and structured organization provides a comprehensive solution for modern knowledge management. The system demonstrates strong potential for real-world deployment with opportunities for further enhancements such as AI-driven recommendations and advanced analytics.

### Challenges And Limitations

The proposed Nexus Second Brain Web Application faces several challenges related to data management, system scalability, and real-world usability. Since the platform is designed to handle heterogeneous data sources such as notes, documents, web links, and multimedia content, maintaining consistency and structure

across diverse formats becomes a complex task. Variations in data types, incomplete metadata, and unstructured inputs may affect the efficiency of content organization and retrieval.

One of the primary challenges lies in the accuracy of semantic search and tagging mechanisms. The effectiveness of retrieval largely depends on the quality of metadata and tags associated with the stored content. In cases where tagging is inconsistent or insufficient, the system may return less relevant results. Additionally, while basic NLP techniques improve contextual understanding, they may not fully capture complex semantic relationships or user intent, especially in ambiguous queries

Another limitation is related to system scalability and performance. As the volume of stored data increases, the system may experience higher latency in search and retrieval operations. Although indexing and optimized database queries improve performance, handling large-scale datasets and concurrent users may require advanced techniques such as distributed databases, caching strategies, and load balancing.

The real-time synchronization mechanism also introduces challenges in maintaining data consistency across multiple devices. In scenarios involving simultaneous updates from different devices, conflicts may arise, requiring effective conflict resolution strategies such as version control or last-write-wins policies. Without proper handling, this may lead to data inconsistencies.

Overall, these challenges highlight areas for improvement, including enhanced semantic understanding, scalable infrastructure, robust conflict resolution, and advanced security mechanisms, to further strengthen the system for large-scale and real-world applications.

## References

J. Smith and T. Brown, –Personal Knowledge Management Systems: A Review of Tools and Techniques, || *Journal of Knowledge Management*, vol. 22, no. 3, pp. 145–160, 2018.

K. Lee and R. Patel, –Web Clipping and Retrieval Optimization for Digital Knowledge Repositories, || *IEEE Transactions on Knowledge and Data Engineering*, vol. 30, no. 5, pp. 987–999, 2019.

M. Garcia and A. Singh, –Intelligent Tagging Systems Using NLP for Knowledge Management, || *ACM Computing Surveys*, vol. 25, no. 2, pp. 1–28, 2020.

L. Zhang and S. Kumar, –Cross-Device Synchronization Techniques for Cloud-Based Information Systems,|| *Journal of Cloud Computing*, vol. 15, no. 4, pp. 225–240, 2021.

P. Davis and E. Thompson, –User-Centric Design Principles for Productivity and Knowledge Tools,|| *Human-Computer Interaction Journal*, vol. 18, no. 1, pp. 55–70, 2022.

R. Chen, L. Wu, and Y. Zhao, –Semantic Search and Metadata-Based Retrieval in Modern Web Applications,|| *International Journal of Web Engineering and Technology*, vol. 14, no. 3, pp. 210–227, 2023.

MongoDB Inc., –MongoDB Manual: NoSQL Database Documentation,|| 2024.

Node.js Foundation, –Node.js Documentation,|| 2024.

React Documentation, –React: A JavaScript Library for Building User Interfaces,|| 2024.

Express.js, –Fast, Unopinionated, Minimalist Web Framework for Node.js,|| 2024.

Elastic N.V., –Elasticsearch: Distributed Search and Analytics Engine,|| 2024.

T. Berners-Lee, R. Fielding, and L. Masinter, –Uniform Resource Identifier (URI): Generic Syntax,|| IETF RFC 3986, 2005.

R. Fielding, –Architectural Styles and the Design of Network-based Software Architectures,|| Ph.D. dissertation, Univ. of California, Irvine, 2000.

C. Dwork and A. Roth, –The Algorithmic Foundations of Differential Privacy,|| *Foundations and Trends in Theoretical Computer Science*, vol. 9, no. 3–4, pp. 211–407, 2014.

J. Dean and S. Ghemawat, –MapReduce: Simplified Data Processing on Large Clusters,|| *Communications of the ACM*, vol. 51, no. 1, pp. 107–113, 2008.