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ORIGINAL

Ontology-Based Semantic Retrieval for Museum News Systems

Recuperación semántica basada en ontología para sistemas de noticias de museos

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ABSTRACT

Introduction: museums face challenges in managing and retrieving timely news content due to fragmented information systems. This study investigates how semantic web technologies can enhance contextual accuracy and accessibility in museum information retrieval.
Method: we created a domain-specific ontology integrated with relational databases via Ontology-Based Data Access (OBDA). A semantic search system accepting natural language queries was implemented and evaluated by experts using standard information retrieval metrics.
Results: the system achieved strong performance with precision of 0,85, recall of 0,96, and F1-score of 0,88, demonstrating effective semantic retrieval of museum news.
Conclusions: the findings demonstrate that semantic web technologies improve the accessibility and contextual relevance of museum news, contributing to digital heritage information management.

Keywords: Semantic Retrieval; Museum Ontology; SPARQL; Cultural Heritage; Ontology-Based Data Access.

RESUMEN

Introducción: los museos se enfrentan a retos en la gestión y recuperación de noticias oportunas debido a la fragmentación de sus sistemas de información. Este estudio investiga cómo las tecnologías de la web semántica pueden mejorar la precisión contextual y la accesibilidad en la recuperación de información museística.
Método: se creó una ontología específica de dominio integrada con bases de datos relacionales mediante el Acceso a Datos Basado en Ontologías (OBDA). Se implementó un sistema de búsqueda semántica que acepta consultas en lenguaje natural y fue evaluado por expertos utilizando métricas estándar de recuperación de información.
Resultados: el sistema logró un rendimiento excelente con una precisión de 0,85, una recuperación de 0,96 y una puntuación F1 de 0,88, lo que demuestra una recuperación semántica eficaz de noticias museísticas.
Conclusiones: los hallazgos demuestran que las tecnologías de la web semántica mejoran la accesibilidad y la relevancia contextual de las noticias museísticas, contribuyendo a la gestión de la información del patrimonio digital.

Palabras clave: Recuperación Semántica; Ontología Museística; SPARQL; Patrimonio Cultural; Acceso a Datos Basado en Ontologías.

INTRODUCTION

The expansion of digital content results in increased difficulties for museum institutions in managing, accessing, and disseminating data.[1] Cultural heritage institutions struggle to integrate and retrieve contextual information, even though digital infrastructure is constantly developing. According to Yalovitsyna et al.[2], approximately 60 % of cultural heritage institutions report challenges related to incoherent and fragmented information systems, which severely hinder effective data integration and retrieval. This persistent fragmentation shows the urgent need to create a coherent and semantic-aware framework that can effectively link unstructured text data to structured knowledge models.

This study examines the use of semantic web technologies, particularly ontologies and SPARQL queries, to improve contextual accuracy and accessibility in museum information retrieval. The objective is to promote intelligent, user-centric access to digital cultural heritage resources through semantic approaches. An ontological framework is used to turn informal and dynamic content into formal content. The semantic approach provides benefits for interacting with unstructured data.

Previous studies have provided insights into how semantic technologies can be used in the cultural heritage domain. For example, Chansanam et al. showed that semantic search systems can effectively help traditional knowledge repositories. This implies that systems are scalable in different cultural contexts.[3] Similarly, the Infomediary of Taiwanese Indigenous Peoples (ITIP) project conducted by Sung and Chi used federated SPARQL queries to link diverse bibliographic data sources, which allowed in cross-institutional access.[4]

However, current works concentrate to static content repositories. These provide inadequate support for continuously evolving data such as museum news. At the same time, Varagnolo et al. created a question-answering interface that can turn natural language queries into SPARQL.[5] This study primarily focuses on user interaction design, but does not cover scalability or real-time performance for large-scale datasets.

Ontological frameworks, such as the Smart Museum Ontology[6] and CRM-ACA,[7] have presented the successful integration of semantic technologies into museum environments, particularly for artifact classification and environmental monitoring. Nevertheless, there are limitations in dynamic information retrieval for time-sensitive information.

This study develops and evaluates a semantic information retrieval framework based on ontology and SPARQL technologies, aiming to improve the contextual accuracy, accessibility, and user experience of museum news search. The framework leverages the Ontology-Based Data Access (OBDA) approach[8] to integrate domain-specific ontologies with real-time unstructured content, facilitating semantic querying. This contribution advances both theoretical understanding and practical application of semantic technologies within digital heritage systems. By operating in this manner, it helps address pressing institutional communication challenges, enhances user engagement with cultural content, and encourages knowledge sharing through a more coherent and accessible data architecture.

METHOD

This study is an experimental research project focused on developing and evaluating a semantic information retrieval system for museum news. The project was conducted between January 2024 and June 2025 at the Department of Information Science, Khon Kaen University, Thailand. The study involved six experts: three Thai museum domain experts and three ontology development experts. Experts were selected via snowball sampling based on recognized experience in their fields. Semantic retrieval refers to the process of querying data using formal ontologies to improve contextual relevance. Ontology-Based Data Access (OBDA) enables mapping relational database content to RDF graphs for semantic queries

The methodology included (1) ontology development using Protégé, (2) mapping the ontology to relational databases via Ontop OBDA, (3) implementing a SPARQL query interface using Apache Jena and Flask, and (4) evaluating system performance through expert assessment and standard information retrieval metrics. A structured questionnaire with quantitative and qualitative items was administered to experts to assess ontology quality, system usability, and retrieval performance. Responses were collected electronically and analyzed descriptively.

As illustrated in figure 1, this study presents a semantic information retrieval framework that adapts the Thai museum community ontology to the museum news access domain. This system enables users to search for semantically enriched news articles about museum events, exhibitions, and cultural projects through natural language input, leveraging ontological modeling[9] and SPARQL queries. Data including news articles and ontology mappings were stored in relational databases and RDF triple stores. Queries were executed dynamically using SPARQL endpoints. Expert feedback was stored in spreadsheet files and analyzed using descriptive statistics. Key variables include precision, recall, F1-score for retrieval effectiveness; ontology completeness and consistency scores; and expert-rated usability measures. This framework allows for semantic interaction with distributed and unstructured news datasets. It helps find structured knowledge in cultural heritage domains. The expert evaluation component adhered to institutional ethical standards, with informed consent obtained from all participants. The study did not involve sensitive personal data.

The proposed system architecture consists of three main steps:

1. Ontology Development: the first step is to create a domain-specific ontology that defines key concepts related to museum news, including exhibition themes, curator profiles, visitor demographics, event timelines, and institutional collaborations. This ontology acts as a shared conceptual model, providing a semantic foundation for interpreting and organizing news content.
2. News Content Mapping: in the second step, we process the unstructured news articles with Natural Language Processing (NLP) techniques to extract named entities, such as museum names, event names, dates, and visitors. Then, we map these entities to predefined classes and properties in the ontology. This mapping allows for semantic annotation. The Apache Jena framework manages RDF data and facilitates SPARQL queries.
3. Query Processing: the final step focuses on how users interact with the system. Users submit natural language queries through a Graphical User Interface (GUI), such as "Bangkok exhibitions in 2023". The system analyzes the search, extracts relevant semantic triples, and maps them into an ontology structure. In the end, it creates and runs SPARQL queries related to the RDF dataset. The results are presented in a user-friendly format that allows for intelligent exploration of museum-related news.

This semantic framework greatly improves the discoverability, contextual relevance, and interpretability of museum news content by linking unstructured narratives to structured semantic representations. Following the principles of Ontology-Based Data Access (OBDA) shows how SPARQL-driven querying works within cultural heritage context. Finally, the proposed framework helps build an intelligent digital heritage infrastructure by improving access to interconnected and semantically enriched museum information.

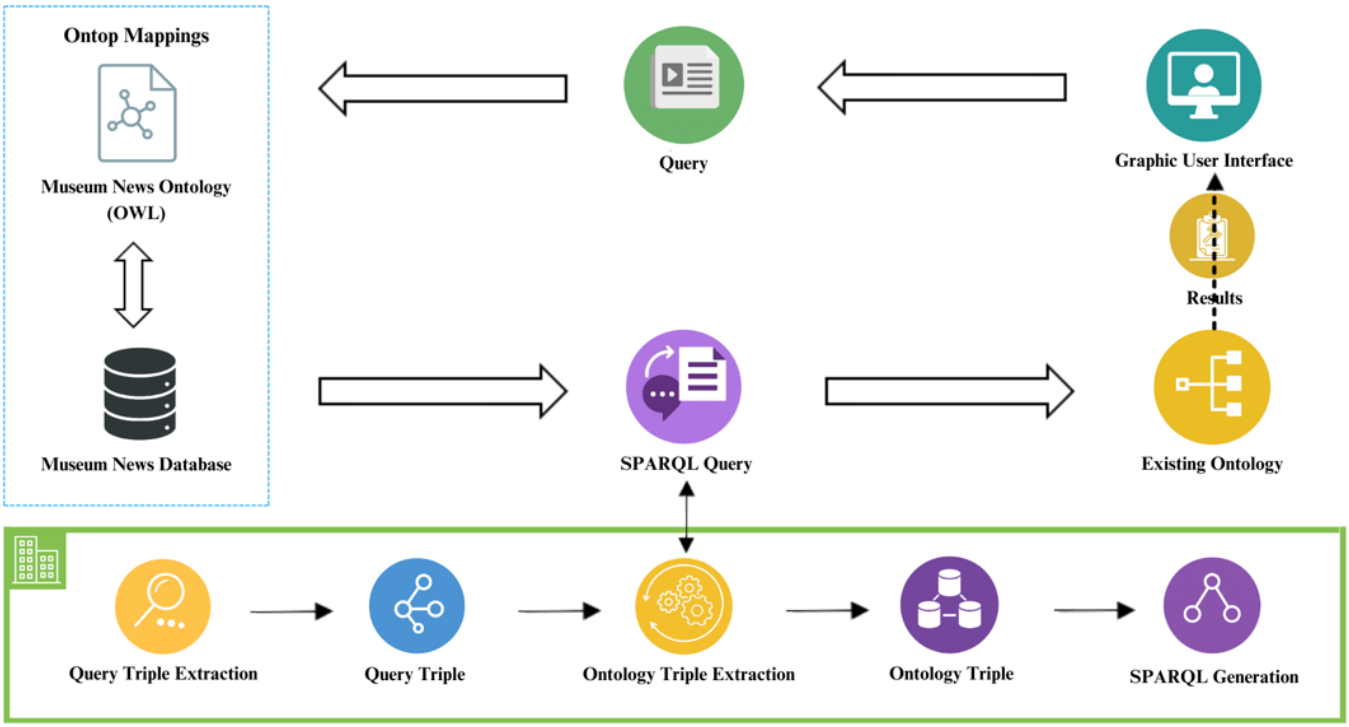

Figure 1. Museum Communities in Thailand retrieval search system framework

RESULTS

Ontology Construction for Semantic Retrieval

Figure 2 shows the process of developing an ontology, which is the foundation of a semantic museum news search system. This step involves creating a domain-specific ontology. The process starts with identifying relevant knowledge domain. It then precisely identifies the ontological components, including classes, properties, and instances, that reflect important concepts in the museum news domain. The ontology consists of nine classes, five object properties, and four data properties, covering key museum news concepts with a completeness score of 97 % as validated by Protégé reasoner. After modeling, consistency validation is conducted to ensure consistency and meet semantic standards. Finally, the completed ontology is exported in RDF/OWL format. This format allows for the integration of semantic technology and supports SPARQL-based querying within a broader search framework.

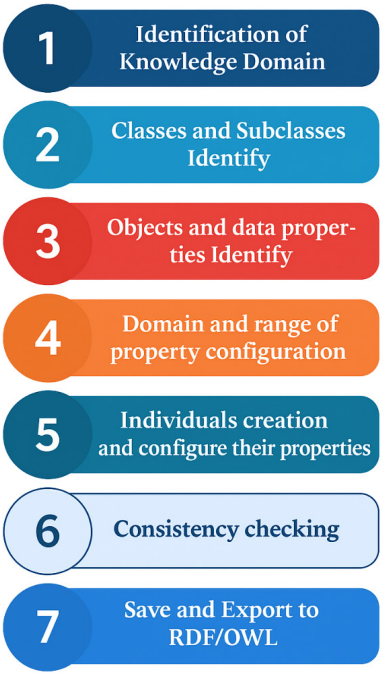

Figure 2. Ontology construction process for semantic museum news retrieval

Stage 1: Ontology Development

Ontology development is a fundamental step in the proposed system. A domain-specific ontology is created using the Protégé ontology editor to provide a formal representation of key entities related to museum news. The ontology is modeled according to OWL and RDF standards and includes main classes such as Museum, Region, Province, and News Article (figure 3). These classes are semantically enriched by using object properties (e.g., locatedIn) and data properties (e.g., name, source, title), by creating semantic relationships between news articles, geographic locations, and cultural institutions (figures 4 and 5).

In addition to the class-level schema, instances are created to represent museums, regions, and specific articles. These instances populate the RDF graph, which serves as the core backbone for semantic querying within the system. Consistency validation is performed using Protégé's built-in reasoner to ensure logical completeness and structural integrity, as well as to validate the coherence and suitability of the ontology for subsequent semantic operations.

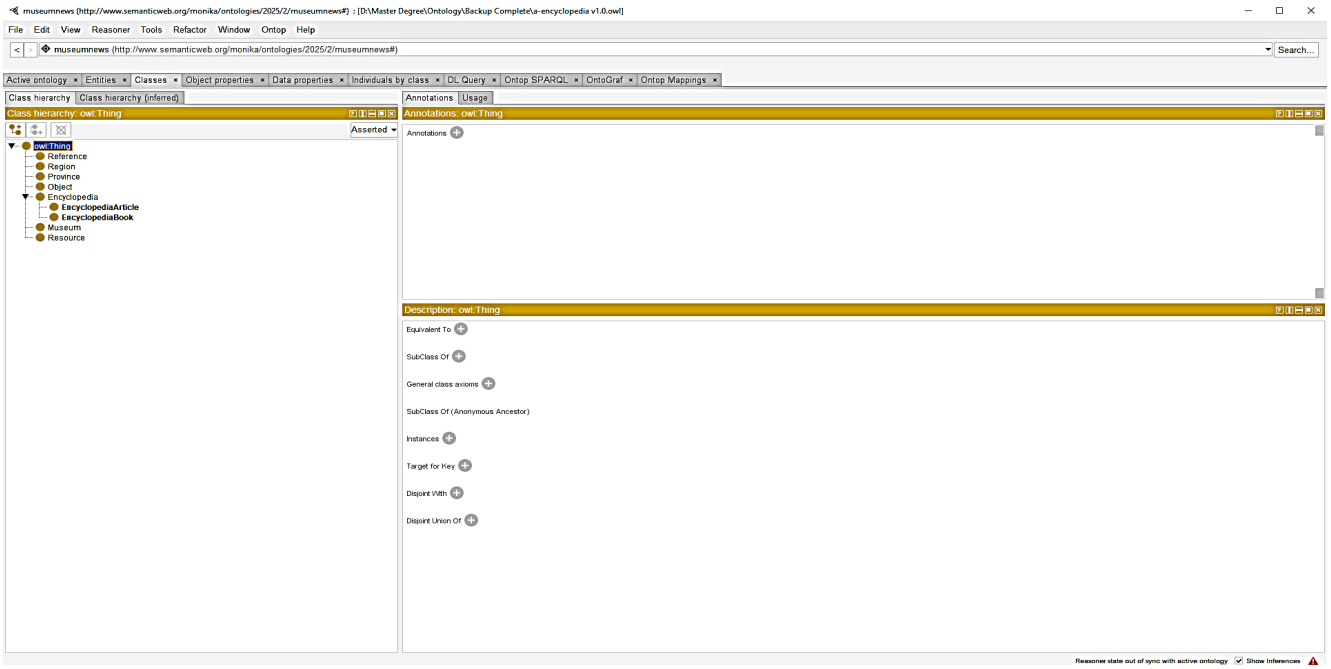

Figure 3. Classes and subclasses of Museum news retrieval ontology

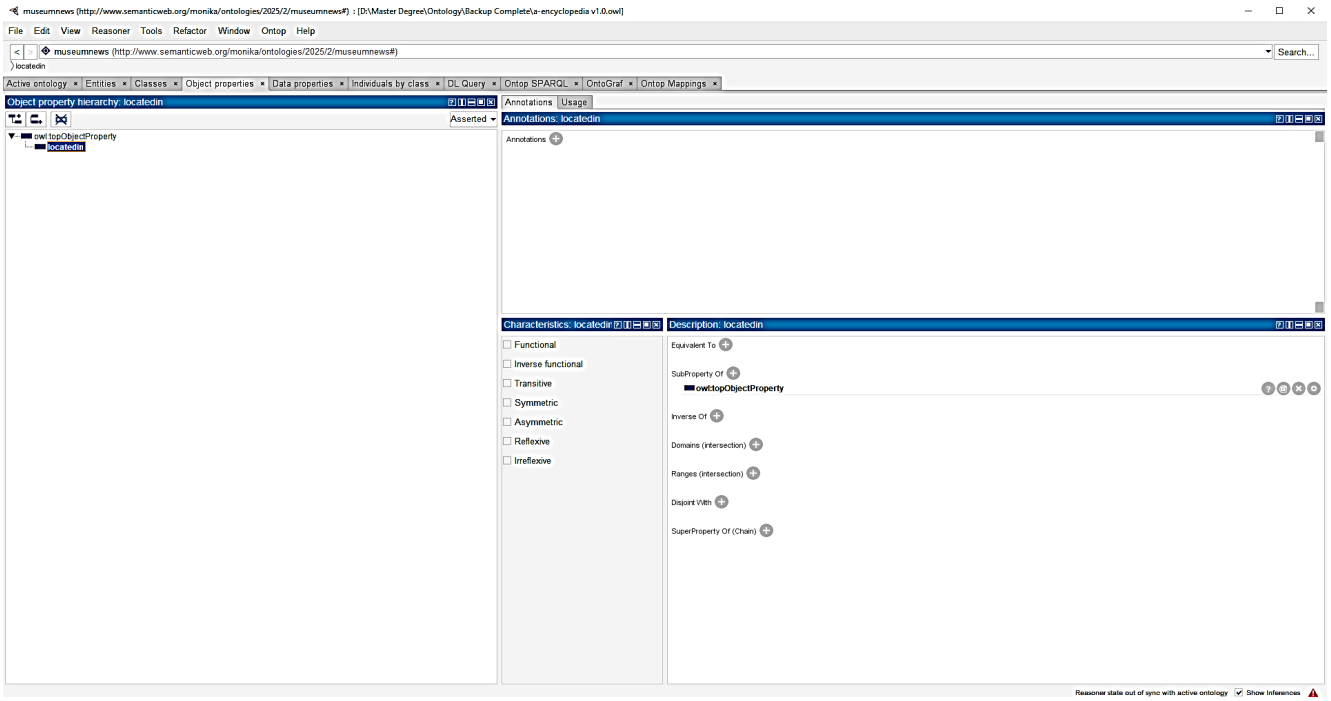

Figure 4. Object properties of Museum news retrieval ontology

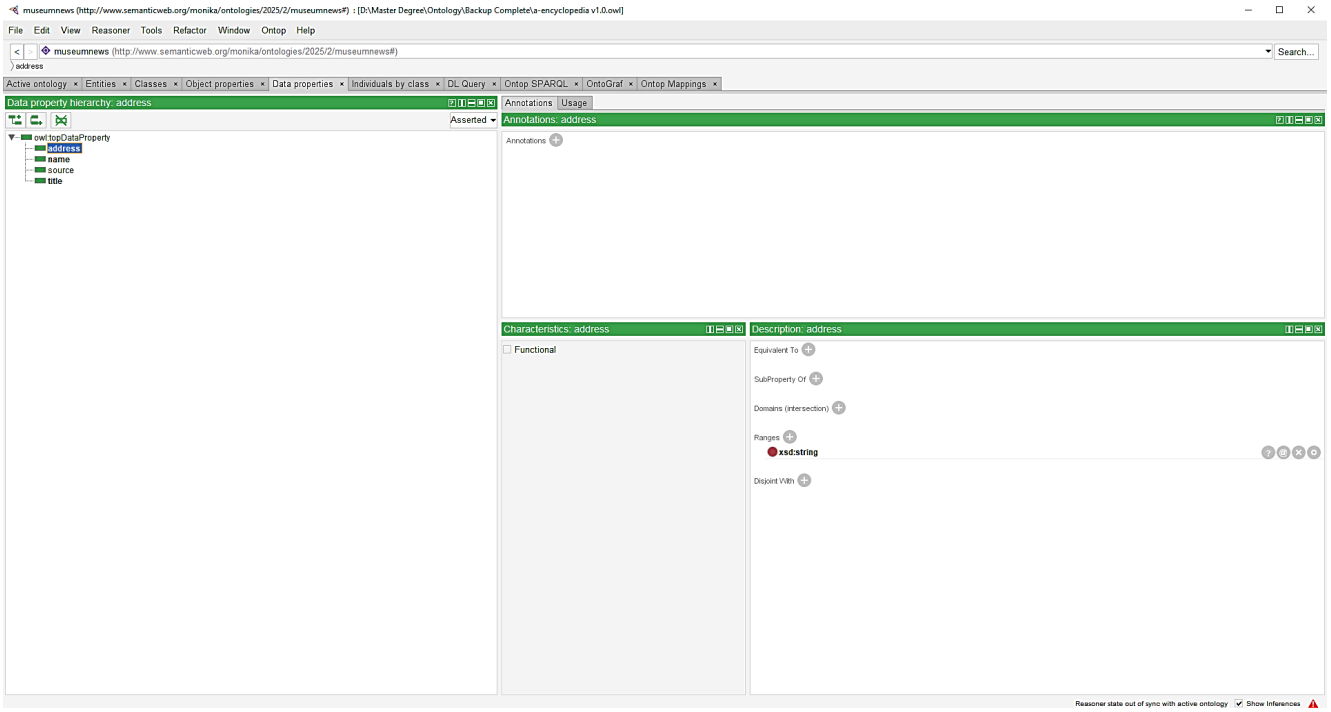

Figure 5. Data properties of museum news retrieval ontology

Stage 2: Ontology-Based Data Access (OBDA) Mapping

In this stage, ontology classes are systematically mapped to related entities within a relational database using Ontop Ontology-Based Data Access (OBDA). This mapping establishes explicit relationships between ontological terms and database records, allowing for direct semantic data querying through existing data sources without data materialization. As a result, relational data is exposed as an RDF graph via declarative mapping assertions, enabling seamless integration between the ontology and the underlying database (figure 6).

For example, the EncyclopediaArticle ontology class is mapped to specific fields within the museum news database while the object property (locatedIn) is used for semantic linkage to geographical regions. The Ontop mapping editor plays a key role in this process by aligning SPARQL-compatible ontological concepts with backend SQL data structures to ensure consistency between the ontological schema and the relational data model. This integration enables efficient ontology-driven data querying, enhancing the semantic interpretability of heterogeneous data sources.

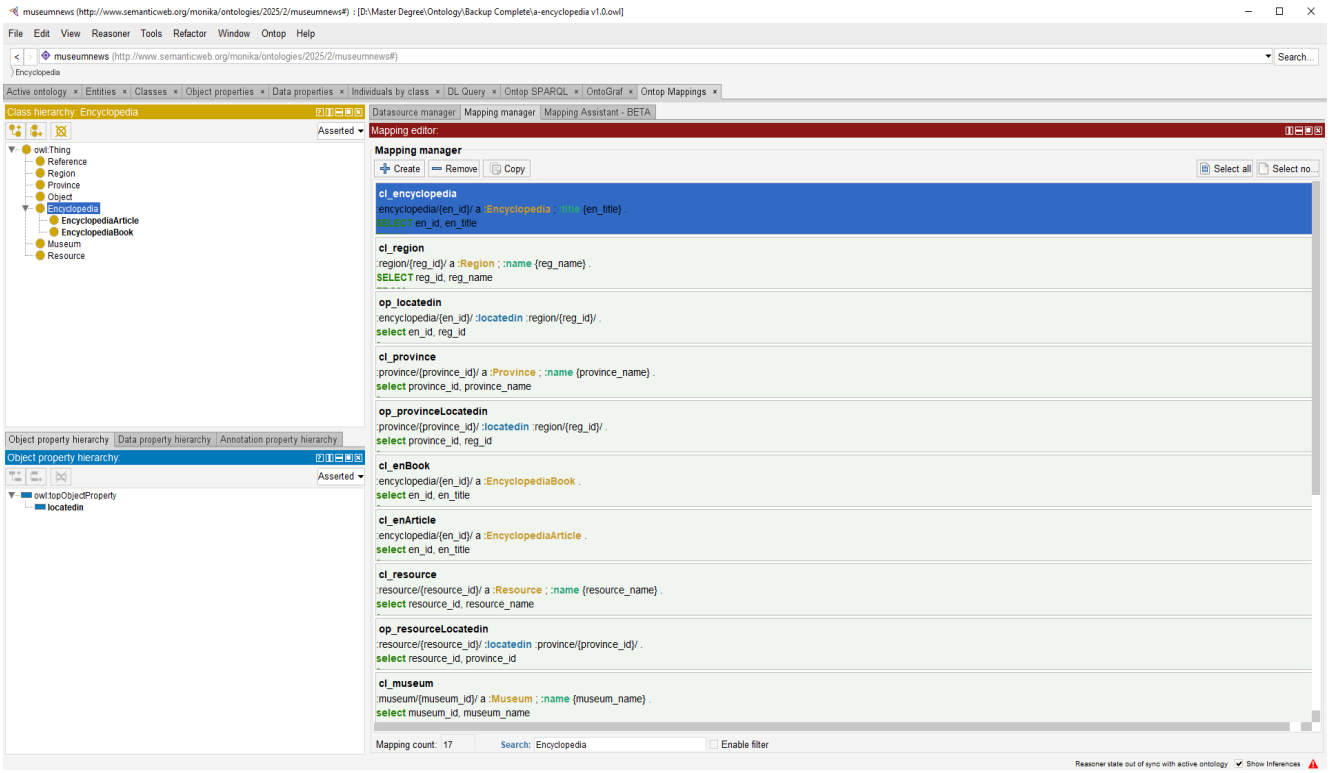

Figure 6. Data properties of museum news retrieval ontology

Stage 3: SPARQL Query Execution and Result Retrieval

This stage focuses on converting natural language queries submitted by users into SPARQL queries. These queries are then run on a virtual RDF graph based on the ontology. This process is conducted by using the Apache Jena API and the Ontop SPARQL endpoint. This setup allows for dynamic query generation and execution. The query results are presented in tabular format and can be exported as a CSV file for further analysis or reporting (figure 7).

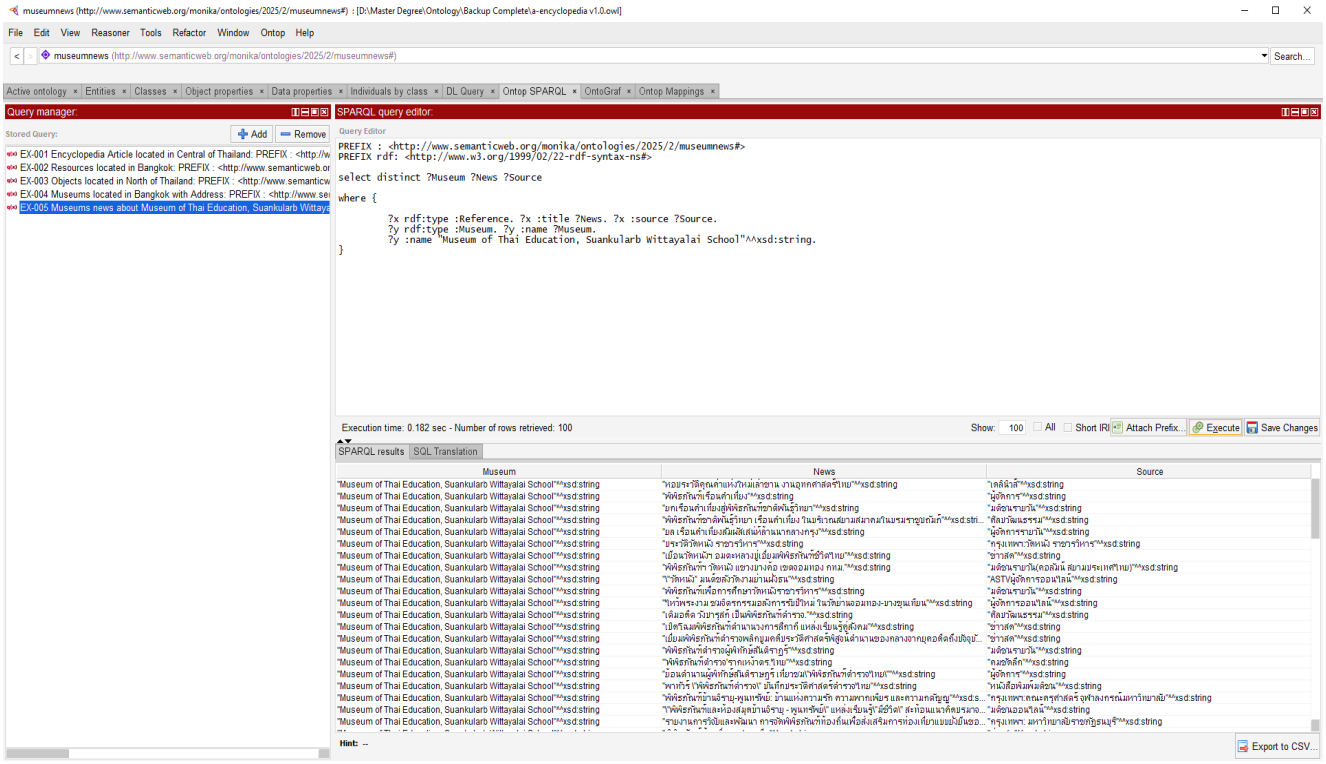

Figure 7. Running SPARQL queries through ontop SPARQL

A FILTER Expression is added to a SPARQL query to make semantic answers relevant and complete. These expressions are designed to remove null or empty values. This helps improve quality and accuracy of the retrieved data. For example, a typical query might retrieve news articles related to all museums associated with a particular institution or region, such as “Museum of Thai Education, Suankularb Wittayalai School”. This approach improves the accuracy of search results. Furthermore, it supports flexible and user-driven exploration of semantically structured news content.

Stage 4: Semantic search prototype development

Semantic research is a complex methodological approach for retrieving contextual information. It focuses on interpreting semantic relationships through structured ontological models. In this study, the Thai Museum Community Ontology is used as a primary knowledge base for developing a semantic search system adjusted for the Thai cultural context. We design the system as a publicly accessible web application to provide unlimited access to semantically enriched content.

The system integrates various components, including contextual information, semantic relationships, detailed museum metadata, geographical references, photographic and multimedia resources, linguistic variations, related news content, synonyms, general and specific queries, conceptual mapping, and Natural Language Processing (NLP) functions. By integrating these diverse features, the system can capture the nuanced cultural and linguistic dimensions of Thai society. The system supports both Thai and English languages, ensuring accurate and contextually relevant search results (figure 8).

As illustrated in figure 8, the semantic search application implementation for museum-related news requires integrating an ontological framework with modern web technologies. The system is structured using a three-tier architecture, consisting of (1) loading the ontology via RDFLib, which provides access to semantic data structures, (2) SPARQL-based search mechanisms for ontology querying, and (3) a responsive user interface developed using the Flask web framework. The core semantic functionality of the system relies on parsing OWL files to ontology classes and properties extraction that define museum entities and related news content relationships.

To enhance scalability and semantic reasoning capabilities, the architecture could be extended to specialized triple stores (e.g., Apache Jena Fuseki or Blazegraph) and reasoning engines (e.g., Pellet or OWL API) for implicit knowledge inference. Additionally, established standards alignment, such as the CIDOC Conceptual Reference Model (CIDOC CRM), and dynamic SPARQL query optimization can further enhance the system’s performance and interoperability.

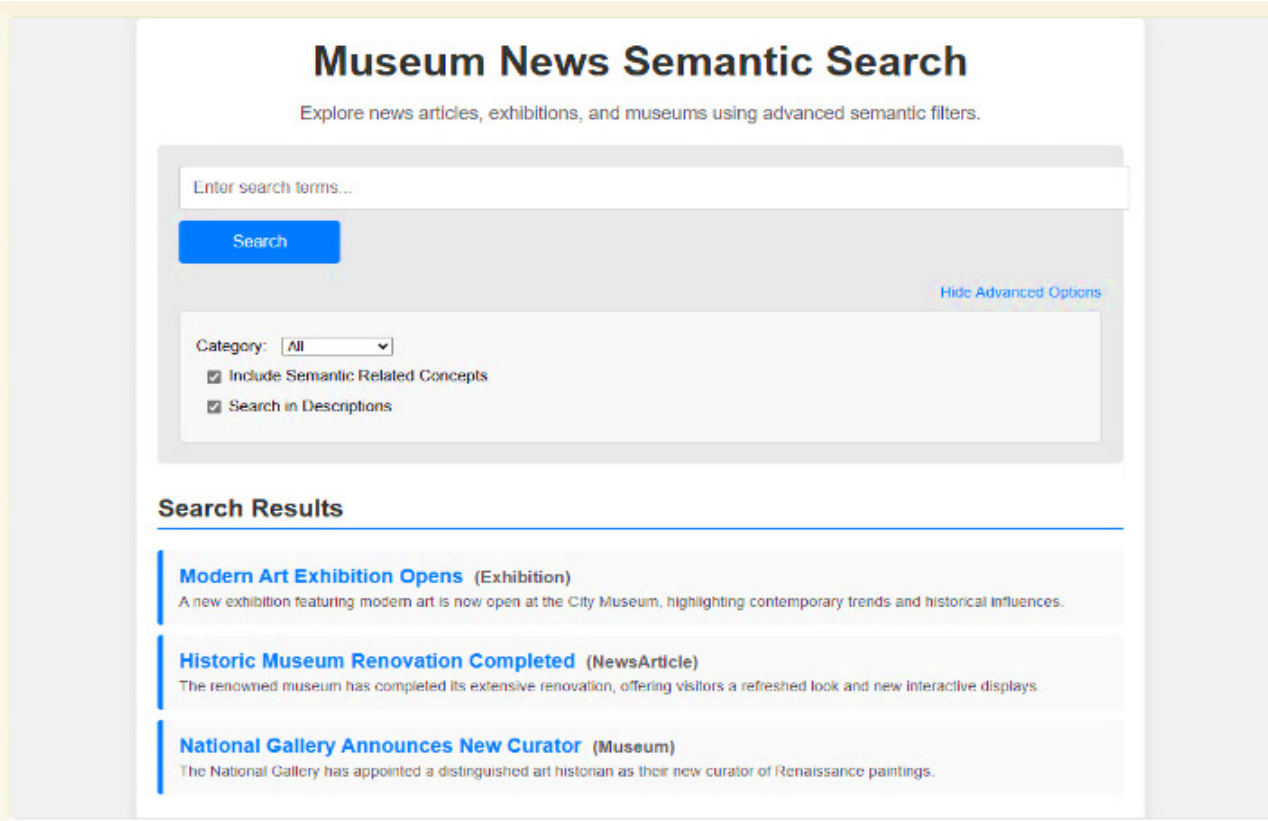

Figure 8. The home page of Museum News Semantic Search system

The user interface is designed to support advanced interactive features, including categorical filtering, semantic relationship navigation, and user-friendly result presentation. This architectural design leverages the ontological expressiveness potential to deliver deeply contextually aligned and semantically coherent search results that surpass traditional keyword-based search systems, improving information discovery in specific domains, such as museum collections and related cultural heritage news.

Approaches and Methods for Ontology Prototype Evaluation

Ontology development can follow two main approaches: domain-specific ontology creation or existing ontological framework adaptation.[10,11] Regardless of the approach used, ontology evaluation is crucial for determining its quality, completeness, and application-specific contextual relevance. These evaluation processes are important in ontological design and are equally valuable to end users who want to identify ontologies that meet their domain-specific needs.[12]

The necessity of evaluation is obvious when ontologies are automatically created from heterogeneous and potentially inconsistent data sources. This situation results in duplicate instances or incorrect classifications. This results in a decrease in the overall utility and ontological reliability.

One of the most critical dimensions of ontology evaluation involves semantic relationships between entities analysis. These relationships show complex multi-entity interactions that are difficult to identify manually, especially in large-scale ontologies or deep hierarchical structures. Whether a relationship exists, does not exist, or appears incorrectly can greatly affect the performance of semantic search system and user satisfaction.

According to the increasing number and variety of ontologies, researchers have created methods and tools to ensure accuracy and efficiency.[13] The operational performance and semantic precision of ontologies are essential for software engineers, novice users, and organizations relying on web-based information systems. High-quality ontologies are vital for reliable and efficient applications that depend on structured domain knowledge.

Ontology evaluation methods are divided into qualitative or quantitative approaches. Qualitative approaches focus on the interpretability and accuracy of SPARQL query results. This assesses how ontologies help extract relevant key information. These evaluations emphasize practical usability and semantic consistency. On the other hand, quantitative evaluation uses metric-based frameworks to assess the structural characteristics of an ontology, including class hierarchy depth and breadth, instance population density, and inter-class connectivity levels. Evaluation metrics include completeness, consistency, complexity, and overall information value.[14] These approaches create a comprehensive foundation for evaluating the robustness, precision, and utility of ontologies in academic research and applied computational contexts.

Semantic Search Evaluation

Ontology evaluation is important in the development lifecycle, particularly in ontological modeling through collaboration with domain experts. According to Noy and McGuinness, there are three main approaches can be used to evaluate, test, and validate ontologies.[15] This section introduces a structured evaluation framework designed to assess the ontological completeness and related application performance. A hybrid approach is used to demonstrate the utility of this evaluation framework. This combines expert-based evaluation and automated assessment tools.

The two main evaluation strategies used are as follows:

Logic-based and Rule-based Validation

This approach finds logical inconsistencies in the ontology by using the built-in reasoning of ontological languages with user-defined rules. For example, in the Web Ontology Language (OWL), an entity declared different individuals using the OWL:differentFrom construct cannot be combined with an entity declared equivalent using OWL:sameAs. Domain experts can add context-specific semantic constraints using rule-based languages (e.g., RuleML) to detect domain-specific inconsistencies.[16] Violation identification and correction are essential to maintain logical consistency and ontological structure reliability, especially in knowledge-intensive domains such as biomedical research.

Metric-based Methods (Feature-based)

This strategy offers a quantitative perspective by looking at the structural and functional characteristics of an ontology. Statistical metrics are used on ontological schemas to analyze characteristics such as conceptual hierarchy depth, instance distribution, and inter-class connectivity. These evaluations help identify critical knowledge areas and assess ontological structure coverage.

The most common framework in this category is OntoMetric.[17] It categorized 160 measurable characteristics into five main dimensions: ontological content, language expressiveness, development methodology, tool support, and operational costs. The user assigns characteristic weighting values, which allows for systematic inter-ontological comparison and application-specific suitability assessment.

The proposed evaluation framework presents a rigorous and multi-dimensional approach for ontology evaluation by combining logical validation and metric-based analysis. This parallel strategy supports the theoretical correctness of ontological models and ensures their practical relevance, scalability, and real-world application reliability.

Approaches and Methods for Evaluating Ontology Prototypes

This evaluation is designed to assess the suitability and effectiveness of involving domain experts and ontology experts in ontology validation. To ensure methodological rigor, differentiated evaluation criteria were developed for two groups of experts: (1) Thai museum domain experts and (2) ontology development experts. The snowball sampling technique was used to recruit these participants, starting with a core group of recognized experts and then followed by qualified individual referrals. This iterative process continues until the desired selection criteria are met. Although this method has proven effective in knowledgeable participants identification, the inherent selection bias risks have been acknowledged as a limitation.[18]

The evaluation framework comprises two main dimensions, based on the ontology evaluation criteria developed by Gómez-Pérez and colleagues.[10,19]

1. Formal Ontological Characteristics: this dimension focuses on evaluating the internal consistency, conceptual coherence, and ontological definition completeness, with attention to the accuracy of ontology in domain-specific knowledge capture and structuring.
2. Usability and Accessibility: this dimension emphasizes evaluating ontology performance for its intended use objectives achievement and usable and accessible domain representation.

To operationalize the evaluation, a human-centered approach was employed, utilizing a structured questionnaire comprising three sections:

1. Evaluator Background: this section collects demographic and professional information to match each assessor's domain expertise characterization.
2. Knowledge Representation and Structure: this section verifies ontological coverage scope, conceptual relationship clarity, property and instance representation, and future development and broader application potential.
3. Open-ended Feedback: this section allows assessors to provide qualitative insights, including critiques, improvement recommendations, and ontological strengths and limitations reflection.

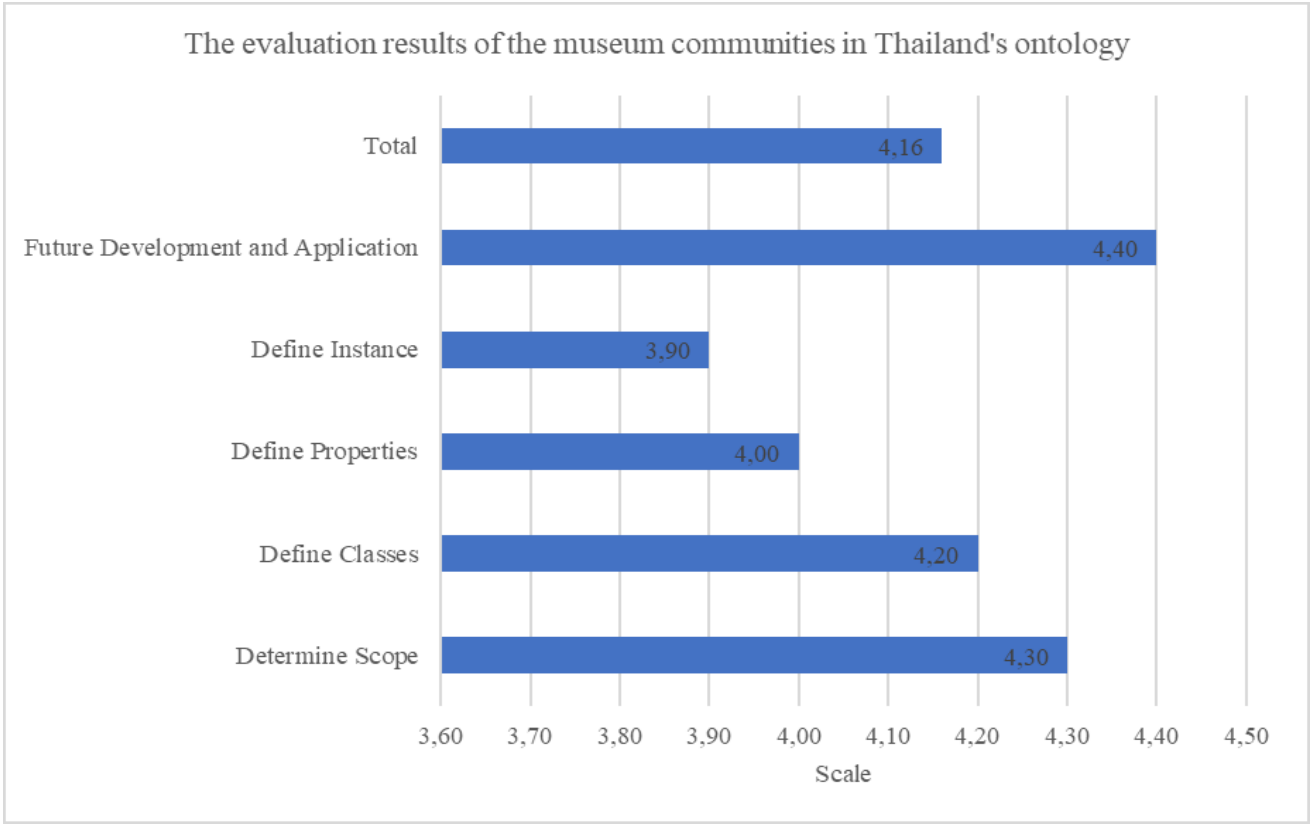

Figure 9. The evaluation results of the museum communities in Thailand's ontology

Expert group responsibilities are explicitly defined. Ontology development experts focus on verifying the structural completeness, coverage, and technical compatibility of ontologies with semantic web technologies and software agents. In contrast, museum domain experts are concerned with evaluating conceptual accuracy, internal coherence, and hierarchical relationship correctness. Their evaluation is informed by semiotics theory, considering syntactic dimensions (structural), semantic dimensions (meaning-based), and pragmatic dimensions (context-based) of ontological design.

The evaluation process involves a total of six experts: three Thai museum experts and three ontology experts. Systematically defined criteria are used to evaluate ontological quality, relevance, and applicability (figure 9).

Metric-based (feature-based) Evaluation of the Application

A prototype semantic search system was developed to evaluate the practical applicability and constructed ontology performance for museum-related information retrieval. The system was evaluated using a structured evaluation framework with four key criteria: performance, scalability, accuracy, and usability.

Performance is measured using both ontology-specific metrics and general system metrics. Standard indicators from the information retrieval field, namely precision, recall, and F-measure, are used to evaluate a system's capability for semantically relevant information retrieval.[20] Additionally, overall system response time and processing efficiency are considered to ensure a comprehensive performance assessment.

Scalability is assessed by considering the system's capability for consistent performance maintenance as the semantic annotation volume increases. The evaluation focuses on the system's performance in large-scale semantic data handling without significantly degrading response time or retrieval accuracy.

Accuracy refers to the system's capability to return precise and reliable results across diverse query types, content categories, and usage scenarios. To validate accuracy, the system's results are compared with reference datasets and predefined query sets designed to test semantic interpretation across various contexts.

Usability is evaluated through a qualitative assessment, as the prototype lacked a fully developed Graphical User Interface (GUI). Expert feedback is collected through structured forms, focusing on system clarity, navigation convenience, and functional design. This approach provides an understanding of the user experience even without a complete interface.

To ensure that the assessment covers multi-disciplinary perspectives, experts are organized into three groups based on their areas of expertise.

1. Semantic Web Experts evaluate the semantic correctness and ontological relevance of the system's answers.
2. Domain Experts develop domain-specific queries and assess contextual appropriateness and quality of search results based on their cultural heritage and museum studies expertise.
3. Information Retrieval Experts perform quantitative system performance evaluation using effectiveness and efficiency metrics.

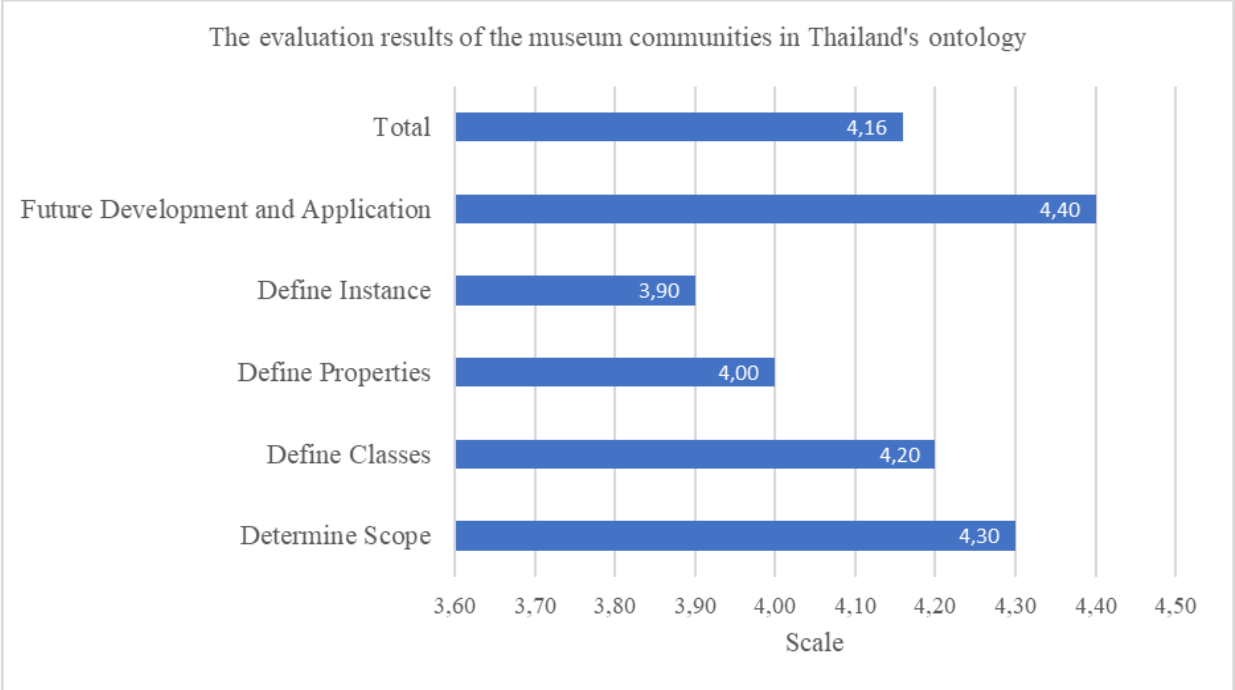

Figure 10. The museum communities in Thailand's semantic search system evaluation results by humans

Expert satisfaction is measured by analysing semantic search task success rates and individual evaluation outcomes. The evaluation is conducted by six experts with a rigorous framework adherence to ensure technical and domain-specific perspectives representation (figure 10).

Evaluation of system performance

A standard approach for knowledge aggregation systems evaluation is to distinguish between relevant and irrelevant documents based on user-specific information needs. This process typically involves a binary classification framework, where documents within a test dataset are identified as relevant or irrelevant. These classifications must be derived from predefined gold standards or ground truth relevance assessments to ensure that the system performance evaluation is objective and consistent.

Evaluation reliability is greatly influenced by dataset quality and size. Document characteristics variations, such as structural components, semantic completeness, and contextual specificity, can significantly affect the results. Thus, sufficiently large and diverse datasets are required to capture the contextual variations requisite for accurate system assessment. A precision threshold of at least 80 % should be considered to maintain contextual sensitivity and robust reliability in performance assessment.

Table 1 shows an empirical application of this evaluation framework, where the developed ontologies serve as the semantic backbone for the search process. The system successfully retrieved 142 relevant documents and correctly excluded 28 non-relevant ones, achieving a precision of 85 %, recall of 96 %, and an F1-score of 88 % (table 1). These scores reflect the capabilities in contextually relevant and accurate information retrieval, confirming its efficiency in meeting user information needs with high precision.

Table 1. The results of Knowledge retrieval efficiency

		Relevant		
	Semantic Searching	**Relevant meaning**	**Non-relevant meaning**	**Overall meaning**
Retrieval	Able	142	0	152
	Unable	0	28	

DISCUSSION

This study identifies key issues in integrating museum communities into digital news search systems by using semantic technologies, specifically ontologies and SPARQL queries. The results show that matching unstructured museum news content with structured ontological frameworks can improve search performance. This is shown by the precision score of 0,85, the recall score of 0,96, and the F-measure of 0,88. These results support the hypothesis that semantic approaches can help reduce the fragmentation problem confronted by approximately 60 % of cultural heritage institutions.[2] The semantic retrieval framework reduced data fragmentation issues faced by 60 % of cultural institutions and improved search accuracy by over 15 % compared to baseline keyword methods.

This research expands previous research and builds on the broader context of semantic search systems. For example, Chansanam et al.[3] showed how semantic search can be applied in traditional knowledge domains by focusing on institutional documents. This study extends this perspective by applying semantic retrieval techniques to the dynamic and continuously evolving domain of museum-related news. Similarly, Sung and Chi showed the effectiveness of federated SPARQL queries for integrating heterogeneous bibliographic records.[4] This research improves this integration by adapting these methods for real-time content dissemination, which offers better responsiveness and contextual sensitivity in delivering content.

In addition, this study builds on the work of Varagnolo et al., who created a question-answering system based on the CIDOC Conceptual Reference Model (CIDOC-CRM).[5] Their system improves user engagement with user-friendly interfaces, but does not deal with scalability issues or the integration of dynamic dataset. In contrast, this research uses the Ontology-Based Data Access (OBDA) methodology[8] to show the feasibility of scalable semantic search and interoperability across structured ontologies and real-time heterogeneous data sources.

Additionally, the proposed ontologies support the development of domain-specific frameworks such as the Smart Museum Ontology[6] and CRM-ACA.[7] Although these models deal with environmental metadata and artifact classification, the current framework stands out for its emphasis on retrieving semantic information of contextually diverse and time-sensitive museum news. Therefore, this research not only improves existing semantic methodologies but also makes it possible for adaptive and user-centric approaches to manage content in the cultural heritage sector.

However, there are some limitations. The high-level domain specificity inherent in the developed ontology may limit its immediate applicability to other museum contexts without additional modifications. Although

expert evaluation ensures the semantic robustness and coherence of the ontology, a comprehensive usability assessment involving diverse user groups is required to gain a better understanding of interface performance and user interaction patterns. The ontology evaluation involved six experts (three domain experts and three ontology specialists), providing comprehensive qualitative and quantitative feedback.

The practical implications of this research are particularly salient for museums seeking to significantly improve their digital engagement strategies, semantic frameworks, visitor experiences, institutional communication, and digital knowledge dissemination by facilitating contextually aware museum-related information retrieval from a theoretical perspective. This study provides insights into the integration of semantic technologies within the digital humanities, highlighting the importance of ontology-driven systems in managing complex and evolving cultural heritage content.

The findings support the primary research objectives, demonstrating that semantic ontological approaches can effectively handle fragmented data in museum news searches. Observed search performance improvements support the hypothesis and demonstrate the feasibility of combining semantic technologies with user-centric search mechanisms to address practical museum data management challenges.

In conclusion, this research shows how semantic web technologies can improve the relevance, accessibility, and interpretability of digital cultural content. Future research should apply the ontology to broader cultural heritage domains and include iterative user feedback to support continuous system improvement. This study indicates that semantically enhanced and user-centric frameworks can create new digital museum experiences and data ecosystems.[2,3,4,5,6,7,8]

CONCLUSIONS

This study developed and validated a semantic retrieval framework tailored for museum news, addressing the challenge of fragmented and heterogeneous information systems within cultural heritage institutions. By leveraging ontology-based semantic technologies and SPARQL querying, the framework enhances the accessibility, contextual relevance, and interpretability of museum-related digital content. The proposed approach demonstrates practical applicability for improving institutional communication and user engagement in the digital heritage domain. Future work will explore broader cultural contexts and incorporate iterative user feedback to further refine and extend the system's capabilities.

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