Chapter 12
Semantic Web Technologies and Its Applications in Artificial Intelligence of Things

Shalini Roy
VIT Bhopal University, India

Harshit Gautam
VIT Bhopal University, India

D. Lakshmi
https://orcid.org/0000-0003-4018-1208
VIT Bhopal University, India

ABSTRACT

Semantic web transforms web search, enhancing data retrieval and storage. It enables machines to interpret online content through diverse technologies for data integration, knowledge representation, and intelligent search. This paradigm revolutionizes information organization, supporting AI, data analysis, and knowledge management. The chapter focuses on AIoT, covering data representation, integration, semantic web applications, control models, and recommendations. Practical case studies illustrate the application of semantic web tools, highlighting real-world scenarios.

TERMINOLOGIES

RDF (Resource Description Framework)
OWL (Web Ontology Language)
SPARQL (SPARQL Protocol and RDF Query Language)
W3C (World Wide Web Consortium)
BIM (Building Information Modeling)
AEC (Architecture, Engineering, and Construction)

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JSON (JSON for Linking Data)
LDJ (Line Delimited JSON)
SSN (Semantic Sensor Network)
HVAC (Heating, Ventilation, and Air Conditioning)
ABAC (Attribute-Based Access Control)
RBAC (Role-Based Access Control)
IoT (Internet of Things)
AIoT (Artificial Intelligence for the Internet of Things)
SWRL (Semantic Web Rules Language)

1. INTRODUCTION

Semantic Web technology is well-known for its transformative capabilities, representing methods and approaches that empower machines to understand and interpret online content. This revolutionizes how we search, analyze, and comprehend information. By enabling machines to comprehend and interpret data, Semantic Web technology introduces groundbreaking possibilities in artificial intelligence, information integration, and information management. It supports data integration, knowledge representation, and intelligent search using technologies such as RDF, OWL, and SPARQL. The Semantic Web presents an innovative approach to organizing and sharing information, backing advanced applications in artificial intelligence, data analysis, and knowledge management. Leading companies like Google, Amazon, and NASA have leveraged Semantic Web technology for operational improvements. Google's Knowledge Graph utilizes semantic data to enhance search results, while Amazon employs semantic technology to improve product recommendations and elevate customer experiences. NASA depends on Semantic Web technology to integrate information from various sources and facilitate information sharing among scientists. These success stories highlight the transformative influence of Semantic Web technology across diverse industries. The inspiration for the Semantic Web traces back to a longstanding vision of the web, influenced by earlier concepts like Vannevar Bush's 'memex' machine from the 1940s, envisioning a universal library with a searchable catalog. Tim Berners-Lee initially imagined the World Wide Web with more detailed document descriptions and links. However, the pursuit of a simple, usable, and universally accessible system led to the present, more human-mediated web (Matthews, 2005). The overview of this chapter is illustrated in Figure 1 and Figure 2.

As Semantic Web technology progresses, it's crucial to consider several noteworthy future trends. These include the emergence of personal advisors utilizing semantic technology, the integration of blockchain with semantic web principles to ensure secure data management, and the development of AI-driven search engines that provide context-aware and precise results. Embracing these standards not only has the potential to revolutionize the industry but also opens up new possibilities for efficient data management and information sharing. In the age of interconnected devices, the integration of semantic web technology into IoT solutions has proven to be a game-changer. This innovative approach enhances the coordination, integration, and intelligence of IoT systems, covering a wide range of devices from everyday smart home appliances to sophisticated technology. A solid understanding of IoT fundamentals is essential to grasp the implications and advantages of incorporating Semantic Web technologies into IoT solutions. Semantic Web technology offers numerous advantages for the development of IoT solutions. Firstly, it facilitates enhanced communication and collaboration by enabling seamless data