Āyurjñānam: Exploring Āyurveda using Knowledge Graphs

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1. Introduction and Objectives

The Bṛhat-Trayī, consisting of Carakasaṃhitā, Suśrutasaṃhitā, and Aṣṭāṅgahṛdaya, is an encyclopaedic reference set in Āyurveda. However, the need for simpler texts led to the emergence of the Laghu-Trayī that includes Mādhavanidāna, Śārṅgadharasaṃhitā, and Bhāvaprakāśa. Authored by Ācārya Bhāvamiśra in the 16th century CE, Bhāvaprakāśa is a comprehensive work focused on medicine. The classification system of varga in its nighaṇṭu section, Bhāvaprakāśanighaṇṭu, categorizes substances based on type, origin, and medicinal properties. This valuable resource assists practitioners and researchers in Āyurveda.

We aim to present the information in an accessible manner to promote wider utilization of this knowledge. Objectives include creating a robust ontology to capture the semantic information of medicinal substances, designing user-friendly interfaces for efficient annotation and curation, performing meticulous manual annotation on Bhāvaprakāśanighaṇṭu, and constructing an accurate knowledge graph. Intuitive interfaces will enable users to explore the graph interactively, enhancing the exploration of Ayurvedic knowledge.

2. Methodology

The Āyurjñānam system is a customized and improved deployment of our previous work, *Sangrahaka* [1], a web-based tool for annotation of entities and relationships towards construction of knowledge graphs. The tool also offers an interface to query the knowledge graph. It uses state-of-the-art technologies, including Python 3.8, Flask 1.1.2, Neo4j Community Server 4.2.1, SQLite 3.35.4 for the backend and HTML5, JavaScript, Bootstrap 4.6, and vis.js for the frontend.

Administrators can manage the system through an administrative interface, performing tasks such as changing user access, creating corpora, and uploading chapters. The ontology creation interface enables addition/deletion of node and relation types while maintaining data integrity.

The *ontology creation process* involved collaborating with Ayurvedic experts to define the concepts, properties, and relationships relevant to the semantic information contained in Bhāvaprakāśanighaṇṭu. The ontology is designed to represent medicinal substances, their properties, and relationships, and is structured in a hierarchical manner.

The *annotation interface* streamlines entity and relationship annotation by providing a row-wise display of lines from the corpus and an annotation area with user input to capture entities and relationships. Auto-complete suggestions based on previous annotations simplify the process. Curators can review and make decisions on annotations. The *curation interface* also allows modifications to node categories and relation types through the context menu, ensuring efficient curation. The process of annotation is similar to our previous work [2].

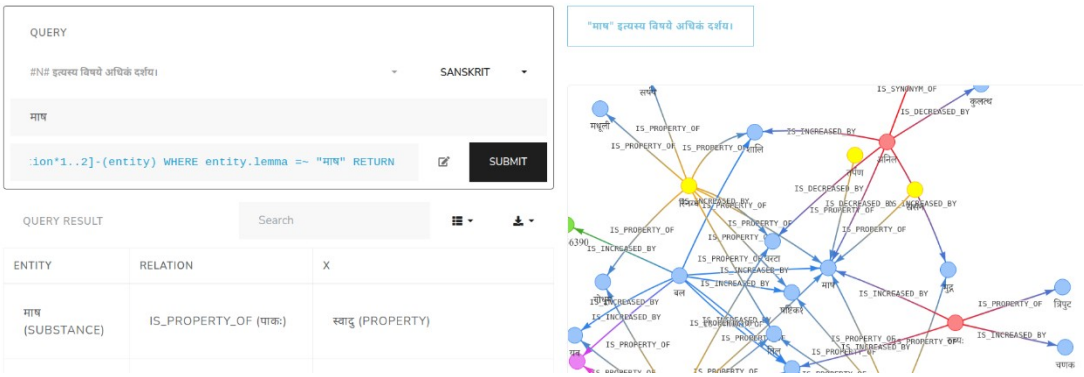

Figure 1: Query interface featuring Sanskrit query templates

The *query interface*, illustrated in Fig. 1, enables users to explore the knowledge graph using pre-defined natural language query templates. By combining these templates with user input, the interface generates graph queries that are sent to the graph database. The results are presented as interactive subgraphs within the interface, allowing users to zoom in on specific areas, rearrange nodes, and save graph snapshots as images. Additionally, the results can be viewed in a tabular format and exported in various file formats like CSV, JSON, and text.

The *graph browser interface* offers an intuitive way to explore interconnected information in the knowledge graph. Users can navigate through neighbouring nodes by clicking on visible nodes. This interface offers options to view all the neighbors of a clicked node, along with the current graph, or replace the current graph with the neighbouring nodes, facilitating a natural exploration of the graph's connections.

3. Results and Significance

The ontology created for Bhāvaprakāśanighaṇṭu, consisting of a significant number of node labels (300) and relationship labels (320), captures a wide range of concepts, properties, and relationships. We use this ontology to perform manual annotation and subsequently construct a knowledge graph (KG) on three chapters from Bhāvaprakāśanighaṇṭu: (1) Dhānyavarga (grains), (2) Śākavarga (vegetables), and (3) Māṃsavarga (meat). The constructed knowledge graph captures 1606 entities and 1707 relationships.

This work holds significant importance in the field of Āyurveda and knowledge representation. The comprehensive ontology and knowledge graph created through manual annotation provide a structured representation of the information present in Bhāvaprakāśanighaṇṭu, enabling deeper insights and analysis. This, thus, acts as a bridge between ancient texts and modern technology, thereby paving the way for new discoveries, applications, and advancements in the field of Āyurveda.

The system is accessible at https://sanskrit.iitk.ac.in/ayurveda/.

References

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2. ‘Semantic annotation and querying framework based on semi-structured Ayurvedic text’. *Hrishikesh Terdalkar, Arnab Bhattacharya, Madhulika Dubey, S Ramamurthy, and Bhavna Naneria Singh*. In World Sanskrit Conference, pages 155–173, 2023.