INDIAN KNOWLEDGE SYSTEM (IKS) IN ARTIFICIAL INTELLIGENCE, ROBOTICS, AND INDIGENOUS COMPUTING: A INTERDISCIPLINARY APPROACH

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Abstract
The Indian Knowledge System (IKS) is a vast repository of indigenous scientific and philosophical wisdom, offering profound insights into mathematics, logic, linguistics, and engineering. This paper explores the intersection of IKS with artificial intelligence (AI), robotics, and indigenous computing, highlighting its potential to influence modern technology. It examines how ancient Indian logic, such as Nyaya, and linguistic frameworks, such as Paninian grammar, contribute to machine learning algorithms and natural language processing (NLP). The study also discusses the application of IKS-inspired algorithms in robotics, emphasizing sustainable and culturally sensitive technological innovation. Finally, the paper addresses the ethical and social implications of embedding indigenous knowledge into contemporary AI systems, promoting fair, transparent, and culturally aware technology.

Keywords: *Indian Knowledge System (IKS), Artificial Intelligence, Robotics, Indigenous Computing, Nyaya Logic, Paninian Grammar, Ethical AI.*

1. Introduction

The Indian Knowledge System (IKS) is an ancient and comprehensive body of knowledge encompassing mathematics, astronomy, medicine, linguistics, philosophy, and engineering (Balachandran, 2020). With the rise of AI and robotics, the principles of IKS offer a unique, culturally grounded perspective that can enhance modern technological frameworks. Ancient Indian scholars made substantial contributions to computing, logic, and automation, which remain relevant today.

For instance, Vedic mathematics offers computational shortcuts that can optimize machine learning algorithms (Balachandran, 2020). Similarly, Panini's grammatical rules provide a structured and formal linguistic framework that can improve NLP accuracy (Panini, 2005). Furthermore, the Nyaya school of logic, with its emphasis on inference and reasoning, offers insights for AI-based decision-making systems (Kumar & Singh, 2019).

By integrating IKS into modern AI and robotics, this paper proposes a sustainable, ethical, and culturally contextualized technological paradigm. The objective of this interdisciplinary approach is to:

1. Analyze the historical contributions of IKS to mathematics, logic, and computing.
2. Explore the application of IKS-based algorithms in AI and robotics.
3. Examine the ethical and cultural impact of integrating indigenous knowledge into modern technology.

2. Literature Review

The literature on IKS and AI is emerging, with growing interest in applying indigenous algorithms to enhance efficiency and cultural relevance in technology. This section reviews existing research on the contributions of IKS to mathematics, linguistics, and logic, as well as its application in AI and robotics.

2.1 Contributions of IKS to Mathematics and Computing

Ancient Indian mathematicians laid the groundwork for modern computing and algorithm design:

- Aryabhata (476 CE) introduced the concept of zero and positional notation, which are foundational to computer programming (Balachandran, 2020).
- Brahmagupta (598 CE) developed rules for operations with zero and negative numbers, concepts vital in modern algorithms (Sharma, 2023).
- Vedic mathematics, based on 16 sutras, offers rapid arithmetic techniques, which have been applied in machine learning algorithms for faster calculations (Balachandran, 2020).
- Sulba Sutras (~800 BCE) contained geometric algorithms used for construction, inspiring computational geometry in AI (Kumar & Singh, 2019).

Research by Balachandran (2020) demonstrated how Vedic mathematical principles could enhance the efficiency of AI models by reducing computational complexity.

2.2 Nyaya Logic in AI Reasoning

The Nyaya school of logic, established by Gautama (circa 2nd century BCE), introduced a system of logical inference based on:

1. Pratyaksha (perception)
2. Anumana (inference)
3. Upamana (comparison)
4. Shabda (verbal testimony)

These concepts align with modern AI reasoning models, such as Bayesian inference and fuzzy logic (Kumar & Singh, 2019).

- Tarka (reasoning) in Nyaya has inspired deductive and inductive reasoning models in AI (Sharma, 2023).
- Hetu (cause) and Drishtant (example) parallel the principles of case-based reasoning in AI (Kumar & Singh, 2019).

Researchers such as Kumar and Singh (2019) have applied Nyaya principles to develop more explainable AI systems, promoting transparency and interpretability.

2.3 Paninian Grammar in Natural Language Processing (NLP)

Panini's Ashtadhyayi (circa 4th century BCE) is one of the earliest known grammar systems. It introduced:

- Meta-rules for generative grammar.
- Formal syntax rules, which are structurally similar to modern programming languages (Panini, 2005).
- Morphological analysis, which inspired tokenization algorithms in NLP.

Paninian grammar's rule-based structure is being used in NLP models to develop more accurate language translation systems (Sharma, 2023). Research by Panini (2005) highlights how Sanskrit's precision and lack of ambiguity make it suitable for AI-driven NLP applications.

2.4 Indigenous Robotics and Computing

Ancient Indian texts describe early forms of automata and mechanical devices:

1. The Yantra Sarvasva by Bhoja (11th century CE) documents mechanical devices, including automated water clocks and self-operating doors (Bose, 2021).
2. The Samarangana Sutradhara, written by King Bhoja, describes humanoid robots powered by water and steam, reflecting early concepts of robotic automation (Bose, 2021).
3. Modern robotics researchers are exploring bio-inspired algorithms based on indigenous knowledge systems, enhancing efficiency and adaptability in autonomous systems (Bose, 2021).

3. Methodology

This research adopts a qualitative and comparative analysis methodology, including:

1. **Textual Analysis:** Studying ancient Indian texts (e.g., Nyaya Sutras, Ashtadhyayi, Vedic mathematics) for computing and algorithmic principles.
2. **Comparative Analysis:** Evaluating the efficiency of IKS-inspired algorithms against contemporary AI algorithms.
3. **Case Studies:** Analyzing real-world applications of IKS in AI, such as NLP and healthcare AI models.

4. Applications of IKS in AI, Robotics, and Indigenous Computing

4.1 Natural Language Processing (NLP)

- **Paninian Grammar:** Used to develop Sanskrit-based NLP models with precise syntax and low ambiguity (Sharma, 2023).
- **Example:** Sanskrit's unambiguous grammar is used for developing high-accuracy machine translation systems.

4.2 AI in Healthcare

- **Ayurveda-Inspired AI:** Machine learning models trained on Ayurvedic datasets for personalized medicine and predictive diagnostics (Bose, 2021).

4.3 Robotics Inspired by IKS

- Ancient Indian automata designs are being revived for modern robotics, promoting energy-efficient and sustainable designs (Bose, 2021).

5. Conclusion

The Indian Knowledge System (IKS) offers valuable insights for AI, robotics, and indigenous computing, promoting efficient, ethical, and culturally grounded technology. By incorporating Vedic mathematics, Nyaya logic, and Paninian grammar into modern AI systems, we can develop more interpretable, efficient, and responsible technology.

6. References

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