Digital Chinese Medicine

Perspective

DeepSeek empowering traditional Chinese medicine: driving the intelligent innovation of traditional medicine

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In the wave of digital and intelligent applications, artificial intelligence (AI) is transforming the development trajectories of industries across the globe. Traditional Chinese medicine (TCM), as a cultural treasure of the Chinese nation, carries thousands of years of wisdom and practical experience. However, in the context of the rapid advancements in modern medicine and technology, TCM faces dual challenges: preserving its heritage while innovating. DeepSeek, a major achievement in the field of AI, offers a new opportunity for the development of TCM with its powerful technological capabilities. Exploring the integration of DeepSeek with TCM not only helps modernize the practice but also promises unique contributions to global health.

1 Overview of DeepSeek technology

DeepSeek is an AI system developed by Hangzhou DeepSeek Artificial Intelligence Basic Technology Research Co., Ltd., built on deep learning techniques to offer advanced cognitive and interactive abilities. Its core model, DeepSeek-R1, uses a Mixture of Experts (MoE) architecture and boasts up to 671 billion parameters, giving it exceptional performance in handling complex tasks. This technical architecture allows DeepSeek to efficiently learn from and analyze vast amounts of data, laying a solid foundation for its application across various fields. From an application standpoint, DeepSeek's exceptional capabilities in natural language processing, logical reasoning, and thought chain generation are particularly notable.

(i) Natural language understanding and generation. Built on the Transformer architecture and attention mechanisms, and pre-trained on large-scale corpora, DeepSeek accurately grasps the semantics, syntax, and pragmatic meaning of natural language texts. It generates fluent, natural, and contextually appropriate text, enabling tasks like semantic analysis, question-answering, and document generation. It also supports multilingual translation, comprehension, and generation. It can process and analyze text data from different fields and styles, whether from daily conversations, professional literature, or literary works.

(ii) Logical reasoning. DeepSeek can process complex logical relationships and make precise inferences and judgments by leveraging reinforcement learning and other techniques. Its ability to simplify the reinforcement learning process through strategy optimization and innovation reduces dependence on labeled data, boosting both training efficiency and inference accuracy. It can dynamically adjust reasoning paths to suit different problems and scenarios. Integrating knowledge from knowledge graphs and external knowledge bases allows the model to incorporate relevant information into the reasoning process, enabling it to leverage a rich knowledge reserve to solve complex problems more effectively and enhance the quality and reliability of reasoning.

(iii) Simulating human thought processes. DeepSeek can break down complex issues into ordered sub-problems such as analysis, reasoning, and validation. It

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demonstrates reasoning paths similar to human thinking, generating thought chains in natural language and revealing the step-by-step reasoning process. This enhances the model's interpretability and allows users to follow how the model derives its final answers, closely mirroring human problem-solving processes.

2 Advantages of DeepSeek empowering TCM

DeepSeek's integration with TCM primarily focuses on applying AI technologies to make TCM diagnosis and treatment more precise, intelligent, and modern. This includes (i) using natural language processing (NLP) to analyze vast amounts of ancient texts and modern literature, assisting in TCM diagnosis and treatment; (ii) employing machine learning to optimize TCM prescriptions, improving effectiveness while minimizing side effects; (iii) utilizing big data analysis to tailor personalized treatments based on patient constitution and medical history; and (iv) leveraging knowledge graphs to integrate Chinese and western medical theories, promoting evidence-based research, and ultimately driving the standardized inheritance and innovative application of TCM. Specific advantages are as follows.

(i) Cultural alignment and heritage. TCM is a cornerstone of Chinese civilization, with a rich history and a unique theoretical system. DeepSeek, as an outstanding example of domestically developed AI technology, has a significant global impact and aligns closely with TCM's independent innovation of culture and technology. For global communication, it better facilitates the understanding and transmission of TCM culture, preventing misunderstandings due to cultural differences, and helping to merge TCM's essence with modern technology, fostering both the inheritance and innovative development of TCM.

(ii) Data security and advantages. DeepSeek is opensourced under the Massachusetts Institute of Technology (MIT) license, enabling global researchers to freely improve the model and encouraging more scientific input into developing large-scale AI models for TCM diagnosis and treatment. Its design is compatible with the multischool heritage of TCM, allowing it to better reflect the idea of full consideration of the environment, individual constitution, and climatic and seasonal conditions. Additionally, DeepSeek ensures full-stack domestic deployment, safeguarding data security and privacy throughout storage, processing, and usage, while also protecting TCM's intellectual property.

(iii) Technical adaptation and optimization. DeepSeek's strong natural language processing and multimodal processing abilities enable it to handle complex textual and multimodal data from the TCM field, including ancient texts, clinical records, and diagnostic images such as tongue manifestations and pulse conditions. Its innovative algorithms support the holistic approach and diagnostic principles of TCM —syndrome differentiation and treatment. Researching TCM applications based on DeepSeek offers cost advantages and makes it feasible for primary-level medical institutions or organizations to develop vertical AI models for TCM.

3 Pathways for integrating DeepSeek with TCM

The integration of DeepSeek and TCM research is driving a profound cognitive revolution. This transformation affects not only technological applications but also the philosophical foundations and methodologies of TCM research. The pathways for this integration are worth exploring. This paper proposes three main approaches to this process.

(i) Reshaping cognition through theoretical innovation. By leveraging DeepSeek's advanced technology, we can innovate the research models of TCM, developing cognitive computing theories for TCM diagnosis and treatment. For example, DeepSeek allows quantitative mapping models to precisely represent abstract TCM concepts, using graph attention networks to simulate diagnostic reasoning and applying complex network theory to analyze TCM's characteristics. Research into human-AI collaborative cognitive models can solve the bottlenecks in joint decision-making between doctors and AI, ensuring that the doctor's cognitive input is preserved while advancing the establishment of new TCM AI diagnostic theories.

(ii) Solving technical challenges. The focus here is on digitally reconstructing TCM theories and using algorithmic modeling to express syndrome differentiation and treatment in computable terms. Based on the syndrome factor differentiation theory, we can build intelligent diagnostic engines, enhance diagnostic accuracy with multimodal technologies, and create a human-AI collaborative intelligence system that supports clinical decision-making, always to assist rather than replacing the doctor's core role.

(iii) Setting benchmarks with application expansion. It is applicable to build an intelligent application ecosystem for TCM with DeepSeek, encompassing clinical decision-making, new drug development, and health management, among other areas. It is necessary to establish an AI standard system for TCM, train interdisciplinary professionals, and build a global research network. Integrating Chinese and western medical research, developing joint decision-making systems is made feasible, focusing on creating knowledge graphs for prevalent diseases and open-source TCM algorithms. This process will gradually cover the entire chain, from technological research and development (R&D) to clinical application, providing a model for the modernization of TCM.

4 Conclusion

DeepSeek's empowerment of TCM and the promotion of intelligent innovation in traditional medicine are inevitable steps. With multiple schools of thought within TCM, there are varying perspectives on understanding diseases, reflected in the diverse treatment plans. This makes it challenging to establish unified evaluation standards. The academic community must strengthen foundational research on the digitalization and intelligence of TCM, promote the representation and integration of TCM's diverse knowledge, and work toward establishing a standardized system for TCM knowledge, thus laying the groundwork for a unified clinical evaluation system. In addition, in-depth research into the theoretical and methodological systems of computational TCM will guide the development, optimization, and iteration of AI models for TCM, ultimately leading to more precise TCM diagnostic services.

Competing interests

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