

# An Experience of Inheriting and Innovating Traditional Chinese Medicine by Artificial Intelligence

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Abstract: In recent years, the Chinese government attaches great importance to the evolution of traditional Chinese medicine (shorted for TCM), put forward the significant deployment of the national strategy of traditional Chinese medicine, has made many significant policies to facilitate the healthy evolution of traditional Chinese medicine. However, there are still many problems in the evolution of traditional Chinese medicine, and it is urgent to use modern information technology and scientific and technological means to inherit and innovative, and promote the modernization and international evolution of TCM. Artificial intelligence (shorted for AI) is one of the three cutting-edge technologies in the 21st century. It has been widely used in many fields and yielded fruitful results, providing technical support and historical opportunities for the evolution of TCM. AI has been widely used in TCM instruments, intelligent auxiliary systems, TCM prescriptions, Acupoints compatibility, and "four diagnoses", etc., and has gained rich practical experience. To facilitate the evolution of TCM, it is necessary to comprehensively collect, deeply excavate and utilize big data information of TCM, further strengthen the integration of AI diagnosis and cure, persist in inheriting innovation and highlighting characteristics, and facilitate the evolution and practical application of TCM theories.

## 1 INTRODUCTION

As Chinese unique health resources, economic resources with great potential, scientific and technological resources with original advantages, brilliant cultural resources and significant ecological resources, TCM acts a significant role in economic and social evolution. As one of the countries with the most serious aging in the world, Chinese aging has brought about digestive diseases, cardiovascular and cerebrovascular diseases, neurological diseases, respiratory diseases and other common diseases of the elderly, which have facilitated the people's urgent need for TCM health services. How to inherit, innovate, revitalize and develop TCM science, and make it act a more active role in deepening the reform of the medical and health system and bringing benefits to human health is a major historical mission of theoretical researchers and practitioners of TCM.

In recent years, the Chinese government paid high attention to the evolution of TCM, formulated the law of Chinese medicine, the "healthy China 2030" planning outline, "much starker choices and graver consequences-in planning evolution of Chinese medicine" and "strategic plan for evolution of Chinese medicine (2016-2030)", informationization, standardization and internationalization have been deployed. The proposal of the national strategy of TCM and its remarkable efficacy in the prevention and cure of common, frequent, chronic and stubborn disease and major infectious diseases, especially the coVID-19 outbreak in early 2020, have made TCM more and more widely recognized by the international community. However, we must also admit that there are many problems in TCM, such as lack of high-level talents, low industry concentration, lack of evolution momentum and innovation motivation, many international constraints, limited international

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competitiveness (Tian 2015). It is urgent to use modern information technology and scientific and technological means to keep innovation and facilitate modernization and international evolution of TCM.

## 2 THE PRACTICAL SIGNIFICANCE OF UPGRADING TCM BY AI

AI is one of the three most advanced technologies in the world since the 1970s, and also one of the three most advanced technologies in the 21st century. As a significant result of the new round of scientific and technological and industrial revolution, AI has been widely used in many disciplines and has yielded fruitful results and successful experience. TCM, as one of the quintessence of China, needs a lot of knowledge accumulation and clinical experience. The cure method is person-specific. The material plan is one for one patient, one disease for one patient, the same disease for different cure, and different diseases for the same cure. The promotion of AI provides technical support and historical opportunity for the evolution of TCM. First, AI could help facilitate the information-based evolution of TCM. For thousands of years, Chinese medicine research has established an extremely large and orderly map of Chinese medicine knowledge, but how to further facilitate the evolution of Chinese medicine through the mining of data value is a significant topic. The emergence of the Internet, especially the arrival of the era of big data, provides a rare opportunity for the informatization of Chinese and Western medicine. AI has a unique advantage in exploring tacit knowledge of TCM. At present, AI supported by big data has been widely used in the medical field. Intelligent auxiliary systems such as medical image, voice recognition, patient care and disease diagnosis have been widely facilitated and used in large and medium-sized hospitals. However, in general, the extension of AI to TCM research depth is not enough, the application field is not wide enough, need to further in-depth research and exploration and practice. Second, AI could help promote the inheritance and evolution of TCM. It can be said that TCM in the inheritance, promotion and application, revitalization and evolution of large pain points and difficulties. In general, the inheritance of famous TCM mainly depends on the inheritance of schools or clinical practice. Such inheritance mode has a long cycle, cannot be copied, and is difficult to popularize and apply. AI can effectively solve these problems. It can

integrate the diagnosis and cure thought, syndrome differentiation logic and prescription experience of well-known old Chinese medicine doctors, form an online learning and auxiliary diagnosis and cure system, improve the medical ability of general doctors, improve the level of disease diagnosis and cure in grassroots hospitals, and help the inheritance and application of TCM. Third, AI could help facilitate the intellectualization of TCM diagnosis and cure. Diagnosis and cure is the core of medicine. The diagnostic process of TCM generally requires information collection through observation, listening, asking and cutting, differentiation of symptoms and signs based on four diagnostic methods, and formulation of prescription by the emperor and the minister. The process is long, with a large amount of information processing and strong dependence on experience, which is not easy to inherit and learn. However, with the use of AI, general physicians can achieve standardized cure through information collection and network, and provide scientific cure plan by simulating the cure mode of differentiation of symptoms and signs of famous doctor of Chinese medicine through AI. Therefore, AI is a significant tool to enlarge the productivity of TCM and a significant starting point for the intelligent evolution of TCM.

## 3 APPLICATION AND PRACTICE OF AI IN CHINESE MEDICINE AND PHARMACY

### 3.1 Application and Practice of AI in Chinese Medicine Instruments

"Chinese medicine four diagnosis instrument" is a great invention in the realm of AI, it is a blend of a large number of advanced scientific and technological achievements and numerous clinical experience of TCM experts, can provide objective TCM diagnosis information collection and analysis, the combination of qualitative and quantitative health status identification, health intervention adjustment suggestion, efficacy evaluation of TCM, and slow disease management covering different levels of the medical and preventive health care system of technical services, acts an extremely significant role in realizing the transformation of TCM to modern Chinese medicine. The principle of treating diseases with Chinese medicine four diagnosis instrument shows Figure 1. In recent years, foreign countries attach great importance to the research and evolution

and production of TCM four diagnostic instruments. South Korea, Japan and other Asian countries have invested a lot of human and material resources to develop TCM and four-diagnostic instruments. South Korea has successfully developed a portable tongue instrument for health detection for families, invested more in the evolution of four-diagnostic instruments for Korean doctors, and Japan has successfully trial-produced a pneumatic pulsar instrument for clinical use. Our country also developed the remote medical cure of TCM, mobile health, wisdom, health and other new type of medical service mode, explore the

practice of internet extends the doctor's advice, the electronic prescription of TCM health service such as network, facilitate the internet technology cure and waiting to remind online booking report query, accurately capture to expend, diagnosis and cure, drug delivery and convenient services, actively build a collection of medical imaging, inspection report and other health records in the integration of medical information sharing service system, and gradually establish a cross hospital of TCM health data sharing interchange standard system.

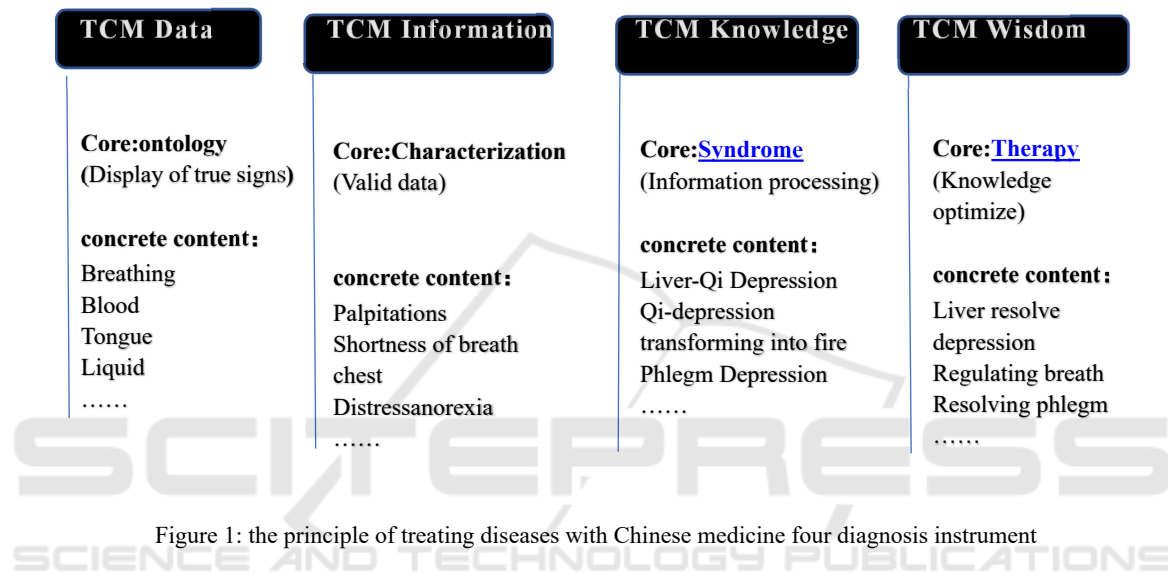


Figure 1: the principle of treating diseases with Chinese medicine four diagnosis instrument

### 3.2 Application and Practice of AI in Tongue Diagnosis

In terms of tongue image acquisition, in order to avoid the influence of external light environment, a spherical diffuse reflection black box was designed (Shen 2007), in which light enters through the opening of the integrating sphere box and diffuses through the inner wall of the integrating sphere for several times, so as to generate more uniform light on the tongue body. Since the tongue image acquired is greatly affected by the tongue posture, an automatic acquisition system was designed to capture complete tongue image information (Lv 2016). In the choice of light source, the traditional tongue diagnosis requires sufficient and soft natural light source, but due to the season, time, weather and other reasons, the ideal light source is always available. Therefore, the International Lighting Commission proposed the standard illumination body D65 to simulate the typical sunlight, the standard light source D50 was proposed (Shi 2004), suggested the use of green lighting to improve the separation of tongue coating

and the recognition effect of point sting, and the use of ring flash was proposed to improve the shooting environment (Wu 2011). In the aspect of tongue image preprocessing, because the illumination environment under standard light source cannot be completely simulated at present, different artificial light sources are restricted by color temperature, color rendering property, spectral continuity and other factors, tongue image has color difference more or less. Hardware correction requires manual white balance according to the change of lighting environment, while software correction is not only accurate color restoration, but also more convenient for clinical collection, which is conducive to practical operation (Xu 2009). Median filtering could effectively protect image edge information while denoising, and it would be a better denoising method in tongue image processing (Zhang 2017). Median filtering was a smoothing method applicable to gray images, which needed to convert tongue images into gray images for processing, while mean shift rule could be directly used to color images, with small calculation amount and good processing effect. In

order to remove the face, lips, teeth and other parts of the image (Lv 2016), the model of Snakes to split the tongue was used (Wang 2003, Jain 1996, Qin 2010), HIS space conversion of the image was proposed (Zhao 1999), while other people proposed the splitting and merging method (Wang 2005).

### 3.3 Application and Practice of AI in Chinese Medicine Prescription

The prescriptions of traditional Chinese medicine on the feasibility of constructing intelligent computing model is analyzed (Ren 2012), the realization of key technology points were summed up, on the basis of set up intelligence technology platform, design the strict treatment prescriptions of traditional Chinese medicine model, determines the prescription data source, data preprocessing, prescription treatment prescriptions and data modeling test, the system debugging and the result analysis and so on. The framework of TCM prescription analysis system based on the existing TCM prescription data resources and TCM prescription analysis system was proposed (Zhu 2014), which supported by information methods and technologies such as artificial intelligence data mining and centering on TCM prescription data. An in-depth investigation of the application of artificial intelligence senses such as electronic tongue, electronic nose, electronic eye, electronic ear and electronic skin in the field of TCM was made (Liu 2016), and their applications of qualitative and quantitative identification of TCM, drug quality control, processing process evaluation were widely introduced. The feasibility of horizontal combination of artificial intelligence sensory multi-technology and vertical combination of modern analytical technology in pharmaceutical field was analyzed.

### 3.4 Application and Practice of AI in Acupoints Compatibility

A management system of TCM acupoints compatibility was designed and developed (Liu 2016), and the law of TCM acupoints compatibility through AI was revealed. Firstly, she analyzes the existing database and completed the TCM acupuncture points management system requirements analysis, summarizes the primary insomnia and gastroparesis two diseases of optimization, and compatibility of the law to obtain the most suitable for intelligent optimization algorithm of map acupoints compatibility of the law, through the acupoints compatibility of TCM management system

of gastroparesis and the simple processing of the data of primary insomnia, provide accurate data for Chinese medicine acupoints compatibility relation graph. The apriori algorithm is used to generate frequent item sets, support degree and confidence degree of acupoints compatibility, forming association rules. The apriori algorithm is further optimized and the Apriori-GA algorithm model of TCM acupoint compatibility management system is established. Secondly, combining the practical application of TCM acupoints compatibility management system with the theoretical knowledge of Apriori-GA algorithm, the software package was written by MATLAB. Based on the data of gastroparesis and primary insomnia in the TCM acupoints compatibility management system, association rules were generated and MCODE algorithm was integrated to develop the TCM acupoints compatibility relation map drawing system. Finally, through continuous testing and improvement, the system can draw the relationship map of TCM acupoints compatibility.

### 3.5 Application and Practice of AI in "Four Diagnoses"

Some people deeply studied the practice and practice of advanced information technology in the "four diagnosis" of TCM (Long 2019, Gao 2007, Tian 2010, Yan 2009). First, in the realm of biomedical engineering, face recognition technology and iris recognition technology are relatively mature. In the future, they will be gradually used as scientific research tools in the realm of TCM diagnostics, with extensive application fields. The facial image tracking model and skin color tracking model are simple and effective. The eigenvector method is effective in determining the size, position, distance, Angle and other attributes of the facial contour of iris, nasal wing, and muzzle Angle, analyzing the corresponding geometric features, and distinguishing the iris changes of various patients. Second, the electronic stethoscope technology is an effective assistant to the aural diagnosis of TCM. Through the comparison and analysis with human olfaction and chemical examination, the electronic nose technology can realize the real-time control of olfaction well. Thirdly, intelligent sensor technology can realize digital medical diagnosis of TCM palpation and obtain more accurate pulse diagnosis information. Fourth, modern information technology is more objective and comprehensive to patients' disease status, evolution trend, past medical history, living habits.

## 4 SUGGESTIONS ON AI TO FACILITATE THE EVOLUTION OF CHINESE MEDICINE

### 4.1 Strengthening the Integration of AI Diagnosis and Cure

AI is an essential tool to assist the research and application of TCM. It has a broad prospect in the realm of productivity expansion and TCM promotion. To strengthen the combination of TCM and AI, according to the characteristics of the evolution of TCM, find the entry point for the combination of AI, research and design more AI achievements in TCM registration, diagnosis and cure, remote diagnosis and cure, late tracking and other aspects, to achieve a further integration of the two.

### 4.2 Comprehensively Collect, Deeply Dig, Develop and Utilize TCM Big Data Information

Big data is the basis and technical support to facilitate the AI of TCM. To increase the experience of TCM, books, and clinical case using big data collection, analysis and mining, through the release of artificial AI diagnosis and cure of pressure, reduce artificial arbitrariness of diagnosis and cure, make the whole process of TCM diagnosis and cure standard and AI system, and realize the single function of TCM diagnosis and cure to focus on the medical diagnosis and cure and service, health information collection and evaluation guidance, health warning and reminder, multi-function, form a diversified clinical data, to better serve patients and facilitate modernization and internationalization of TCM to provide support.

### 4.3 Inheriting Innovation and Highlighting Characteristics, Promoting the Evolution of TCM Theories and Their Practical Application

Inheritance, innovation is the foundation of all work of traditional Chinese medicine, we must insist on and upgrade TCM characteristic advantage, adhere to the original thinking of TCM, make full use of modern science and technology and method, facilitate the evolution of TCM theory and practice, promote the modernization of TCM, constantly form

new features and new advantages in innovation, new generation of Chinese medicine forever.

## 5 CONCLUSIONS

The birth and development of computer technology and artificial intelligence technology make medical intelligent diagnosis and treatment service possible, and its application value has been recognized by the majority of medical workers. Driven by the concept of precise, minimally invasive, curing causes, with the maturity and development of "big data, artificial intelligence, mobile Internet, cloud computing, Internet of things, block chain", artificial intelligence will further profoundly change the face of the future medical wisdom, become an indispensable right-hand man, make a significant contribution to the diagnosis and treatment for various diseases.

## REFERENCES

- Chaosheng Yan, Dan Li, et al (2009). Research and discussion on clinical efficacy evaluation of TCM based on information technology, Chinese Journal of medicine, 37 (2):21.
- Fei Tian, Jun Chang, et al (2015). Major problems and challenges in the study of objectification of the four diagnoses of TCM, tianjin Chinese medicine, 7(7): 445.
- Haibo Gao, Wenxian Hong, etc (2007). Application of modern information processing technology in diagnosis of TCM, Journal of Chinese medicine, 25(8): 1608-1610.
- JAIN A, ZHONG Y, et al (1996). object matching using deform-able templates, IEEE Transactions on Pattern Analysis and Machine Intelligence, 18(3): 267-278.
- Jiatuo Xu, Zhifeng Zhang, et al (2009). Tongue color analysis based on chromatic aberration correction under natural light conditions, Chinese Journal of integrated traditional and western medicine, 7(5): 422-427.
- Jinghua Tian, Jingfeng Tian (2010). Application of modern information technology in the realm of TCM, world journal of integrated Chinese and western medicine, 5(5): 445.
- Jingjing Liu (2016). Research on the Compatibility law of Acupoints based on AI algorithm, Changchun University of Technology.
- Lansun Shen, Yiheng CAI, et al (2007). New progress in tongue image information collection and analysis of TCM, world science and technological modernization of TCM, 9(5): 97-101.
- Meihua Long (2019). Research on the application of modern information technology in the four diagnosis of TCM, guangdong vocational and technical education and research, 6(6): 180.

- Qiang Shi, Weichang Tang, et al (2004). Journal of Shanghai university of TCM, 18(2): 39-41.
- Ruixin Liu, Pengju Chen, et al (2017). AI senses: New technologies in pharmaceutical field, Journal of Pharmaceutical Analysis, (4): 559-567.
- Tingge Ren, Fan Zhang, et al (2012). Conception and flow design of traditional Chinese medicine prescription therapy model based on intelligent computing, Journal of Beijing university of Chinese medicine, 35(8): 524-528.
- Wuxing Qin, Bin Li, et al (2010). A hybrid tongue image segmentation algorithm based on initial Snake contour, Journal of university of science and technology of China, 40(8): 807-811.
- Xiang Zhang, Guangqin Hu, et al (2017). A study on the quality evaluation of tongue images in TCM, World Journal of integrated traditional Chinese and western medicine, 12(11): 1607-1611.
- Yan Zhu, Bo Gao, et al (2014). Chinese Journal of Traditional Chinese Medicine, (5): 1543-1546.
- Yanqing Wang (2003). Integrated Research on TCM Tongue Image Analyzer, Beijing University of Technology.
- Yuanting Lv (2016). Research on the Objectification of tongue Diagnosis based on auxiliary light Source, Tianjin University.
- Yuzhong Wang, Jie Yang, et al (2005). An automatic extraction method of tongue body from tongue image, computer simulation, 22(2): 232-235.
- Zhongxu Zhao, Aimin WANG, et al (1999). Chinese Journal of Electronic Measurement and Instrument, (3): 1-5.
- Zuchun Wu (2011). Discussion on tongue image collection method and application in objective Tongue Diagnosis research, Guangzhou University of TCM.