Journal of Internal Medicine and Emergency Research
ISSN: 2582-7367
Hong G, 2022-Intern Med Emerg Res
Review Article

Advances in the Application of Artificial Intelligence in Chinese Medicine Diagnosis

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Received Date: 05-30-2022

Accepted Date: 06-13-2022

Published Date: 06-20-2022

Abstract

Objective: To study the current situation of the application of artificial intelligence in Chinese medicine diagnosis.

Methods: In the past ten years, the Chinese databases China Knowledge Network, Wanfang database and English databases Pub Med, web of science, Science Direct and Google scholars were used to study the application of artificial intelligence in Chinese medicine diagnosis with the theme words or keywords artificial intelligence, machine learning, deep learning, Chinese medicine diagnosis, Chinese medicine diagnosis and Chinese medicine diagnosis respectively. Machine learning, deep learning, TCM diagnosis, four diagnoses. Intelligent diagnosis, intelligent Chinese medicine, and so on, to filter out the literature related to intelligent Chinese medicine diagnosis, and categorize them by looking, intelligent Chinese medicine diagnosis by smelling, by asking, by cutting, and so on, and conduct a more literature related to intelligent diagnosis of TCM was categorized into intelligent diagnosis of TCM viewing, TCM smelling, TCM questioning, TCM cutting, and analyzed in depth.

Results: The Chinese and English literature on the intelligent research of the four diagnoses of TCM in the past ten years was summarized, and the research hotspots in this field were analyzed in depth on this basis.

Conclusion: Artificial intelligence technology is widely used in TCM clinical diagnosis, and the application of artificial intelligence technology makes TCM diagnosis technology more accurate and can effectively help modernize and standardize TCM research.

Keywords: Chinese medicine diagnosis; Artificial intelligence; Clinical research; Methodology.

Introduction

Traditional Chinese Medicine (TCM) is an ancient medicine, which is the result of thousands of years of experience of the Chinese people in preventing and treating diseases, but the confidence level of TCM diagnosis and treatment is still low, mainly because the traditional diagnosis mode of TCM lacks the objective and quantifiable

Citation: Hong G. Advances in the Application of Artificial Intelligence in Chinese Medicine Diagnosis. J Intern Med Emerg Res. 2021;3(2):1-8.
DOI: https://doi.org/10.37191/Mapsci-2582-7367-3(2)-043

basis. The objective quantification of diagnostic data will open the era of precision medicine for TCM and will significantly improve the accuracy of clinical diagnosis and treatment. To solve the problem of objective quantification of TCM diagnosis, artificial intelligence technology has been introduced in recent years [1].

Artificial Intelligence (AI) is a new technical science that studies and develops theories, methods, technologies, and application systems for simulating, extending and expanding human intelligence [2]. In this study, AI is integrated into TCM diagnosis from the four diagnoses of traditional Chinese medicine (TCM), i.e., "looking, smelling, asking and cutting", to promote the modernization of TCM.

Intelligent research of TCM diagnosis (four diagnoses of TCM)

The research on the objectivity of TCM diagnosis has made significant progress in the quantification of pulse and tongue diagnosis [3], and the AI-based voice recognition technology also provides the possibility of objectivity in the diagnosis [4]. Patients can instantly transmit relevant information to the platform for analysis and recording, and at the same time receive timely feedback from the platform.

Based on the above, an intelligent platform for TCM diagnosis can be established to facilitate and optimize patient information collection, reduce the workload of physicians, and be used for clinical patient screening, disease prevention, patient follow-up, teaching, and scientific research [3,4].

Intelligent Chinese medicine lookout diagnosis

Among the four diagnoses in TCM, tongue diagnosis has been the most intensively studied, and its development in the past thousand years has laid a heavy foundation. In recent years, more researchers have joined the research in this direction and proposed more quantitative ways, for example, LI et al [5] extracted the tongue configure and tongue coating information respectively with the help of hyperspectral technology, which confirmed the high application value of hyperspective technology in tongue diagnosis information extraction. As for tongue diagnosis data information processing, MENG et al [6] designed a constrained high diffusion neural network tongue diagnosis framework based on convolutional neural network, which provides a good solution to the previous problems of data significdistribution and road weight distribution.

Kanawong et al [7] designed a supervised learning tongue image analysis program and developed go mobile health diagnosis terminal based on the data generated during user use Based on the amount of data generated during user during user usage, a classification model was trained to improve its performance. In terms of technical implementation, the focus is on standardized acquisition of tongue images, preprocessing means such as image quality assessment [8] and color correction [9] of the acquired tongue images, as well as performing tongue segmentation and building a tongue image database to prepare for the application of artificial intelligence techniques.

Secondly, it is mainly the study of tongue image feature learning, such as the detection and then dreams of the tongue and the recognition of tongue composition [10], and the extraction of local and global features of tongue images [11]. In conclusion, the study of tongue diagnosis has been more extensive and in-depth, but there is a lack of comparison in the same use and a lack of integration in different uses. The increasing technical maturity shows that objectification studies are feasible and can provide high-quality analytical data in the future. In lip diagnosis, Li et al [12] designed a computer-aided lip diagnosis system based on multilevel classification vector machine, which classified 257 lip images into four categories: vivid, red, light red, and pale through four steps of image processing, feature extraction, feature selection, and feature classification, pioneering the field of lip diagnosis image recognition.

As for facial diagnosis, Zhao et al [13] extracted global and local color features of the face by facial segmentation, followed by dimensionality reduction of the high-dimensional data, and then by using Support Vector Machine (SVM), Naive Bayes (NB), k Nearest Neighbors (KNN) and Adaboost iterative four classifiers were evaluated to obtain the best classification performance by weighted fusion of the best performing classifier with the previous dimensionality reduction data, which finally proved the high analytical value of local features.ZHAO et al [14] trained the SVM classiI Japanese with the two major aspects of color and glossy features finally achieved 86. ZHANG et al [15] distinguished diabetic patients from normal people based on a more advanced sparse representation classifier (SRC) and finally obtained an average accuracy of 97. 54%. The classmates on diagnosis by looking at the face, tongue and lips is mainly based on image processing and machine learning, and the accuracy the recognition accuracy is high through the training of the large amount of data labelips ling, which indicates that the use of image recognition technology can realize the automatic diagnosis of TCM evidence by looking at the face, tongue and lips, and has good prospects. It will become a though What important source of basis for intelligent TCM diagnosis in the future [16]. Kermany et al [17] used a deep learning model based on a migration learning model and trained with many retinal OCT images to correctly identify choroidal neovasculPP, neovascularization, diabetic macular edema, and vitreous warts within 30s. They also obtained reliable diagnoses masfor icians by king tests. AI interpretation of medical images is less susceptible to subjective influences, more efficient, and has a lower misbe diagnosis rate. Through image recognition technology, AI Texpert systems can read medical image data to make more diagnoaccurate ses. At the same time, image recognition can also help AI TCM expert system to look at morphology, read the five senses senses senses, etc., and identify abnormal body conditions. Therefore, through image recognition, the AI Texpert CM system can understand everything inside and outside through the lookout module.

Taiwan legend like Chinese Medicine smell diagnosis

Chinese medicine sniaime is a method to understand the changes in the patient's condition by listening to the sound and smell. Similar to human fingerprints, voice and

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speech patterns are rich in specific information and have a strong discriminatory effect, and today there are many applications acoustic applications of acoustic patterns in the field of security. 2004, Pexcited et al [18] published a study on cytostics stics in science and found that cell growth to apoptosis or changes in survival arrange can have an effect on the vibration frequency of the cell wall. Therefore, from a macroscopic point of view, changes in the sound of an organism may also reflect changes in its retailers and pathological state, which is consistent with the idea of the Huangdi xation jing, a classical Chinese medical text from 2,000 years ago, that the sound can be used to know the subtleties, adjust the subhealth and prevent the diseases of jing. However, human hearing ability is not sufficient to extract, understand, and recognize such small differences, so the objectification of smell diagnosis depends on the research and development of sound and odor sensors. In terms of stics acoustic, the study by WANG et al [19] demonstrated the acoustic differences among females of different ages and females with cold and hot constitution.YAN et al [20] extracted the acoustic features of lung qi deficiency, lung yin deficiency, and healthy subjects based on the Fractal Dimension (Fractal Dimension), trained by a multiclassification SVM training model, and finally obtained 86 86 86. 05% of the recognition the overall in rate. In terms of odor research, WU et al [21] summarized the current state of development of biosensors for taste and smell and divided them into two major categories according to in vitro and in vivo, the former using taste and smell biological tissues and cells and pathtors as sensitive elements to collect stimulus signals, and the latter implanting electrodes in animals to record signals obtained from signaling signals. Good sensors are the basis for the objectification of TCM diagnosis, while the application of bionic sensors in TCM sniffing can enhance the status of TCM sniffing and make it play a more important role in the four diagnoses.

Intelligent Chinese medicine diagnosis

There are two main ways of research on questioning intelligence, one is how to complete questionnaire design by recommendation algorithm, and the other is to combine other treatment methods to improve the efficiency of questioning. For example, Di Fan et al [22] proposed a personalized physical quality query method based on machine learning technology. The questionnaire design first ranked the questions based on the recognition results of the patient's tongue image, thus selecting personalized questions for the patient and greatly reducing the time and number of questions the patient had to answer. Compared to the direct use of the TCM Body Composition Questionnaire, patients answered 68. 3% fewer questions and 80. 3% less time. In addition to determining "what to ask and how to ask" in the intelligent consultation, some studies have also furthered the classification of evidence based on the consultation data.

Intelligent Chinese medicine diagnosis

The pulse diagnosis in Chinese medicine detects fluctuations in the radial artery at the inch and foot to investigate the state of qi and blood flow in the whole body and changes in the five organs and six internal organs. Because pulse diagnosis is non-invasive and

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convenient, it also has good prospects for development in modern medicine. Zhou et al [23] decomposed radial artery pressure into dynamic and static forces for detection, and their designed tactile force sensor reduced the difficulty and cost of production while meeting the requirements of large range and high accuracy, which accelerated the promotion and application of tactile force sensors. While more scholars have investigated the implications of pulse waves, GUO et al [24] used the Hilbert-transformation to time series both normal and cardiac patient pulse signals, and then used a random forest classifier to build a classification model for the extracted features, and finally found that the highest average accuracy of 90. 21% was achieved when the combination of energy features and sample entropy features were used as the input feature vector.

JIANG et al [25] proposed a feature extraction method based on Discrete Fourier Series (DFS) by first splitting the waveform signal into sub-signals of different frequencies and amplitudes and then fitting them with DFS, which finally showed that the error was reduced compared with the previous one. In addition, this method can better represent the original and potential information to better distinguish different physiological and pathological states. Tsai et al [26] studied the differences between different locations and different indicators of radial pulse diagnosis using Fourier Transform (FT) and pointed out that the measurement location should be carefully selected in the study of pulse integrity so as to ensure the acquisition of information integrity of the information obtained. In addition, Lee [27], Moura [28], and HU [29] has also conducted extensive studies on pulse waves in hypertensive patients, and their results can be used as a basis for cardiovascular disease risk studies in the elderly to predict cardiovascular function in the elderly.

Luo et al [30] assessed the risk of hypertension by observing the dynamic changes of pulse waves. The effect of pulse wave on the accuracy and stability of various machine learning models was analyzed, and the accuracy of the assessment was as high as 86. 41% when the Ada Boost method was used, providing a research direction and basis for Chinese medicine in the diagnosis and dynamic evaluation of the efficacy of modern diseases. In conclusion, the overall link of research in pulse diagnosis has been sound, but there is a lack of technical breakthroughs in local nodes. In the future, there is still a need to improve the accuracy of the sensors, avoid measurement bias, find the characteristic points of different evidence waveforms, and improve the recognition efficacy of the model.

Other

Current research hotspots include both data and system construction and multi-information fusion, in addition to focusing on how to achieve intelligence for a particular diagnosis. For example, Shi et al [31] used an intelligent tongue and pulse analyzer to collect tongue image and pulse map data and built a comprehensive classification model based on both information to identify qi deficiency and yin deficiency in non-small cell lung cancer, and Fan et al [32] performed TCM questioning based on tongue image recognition to realize a diagnosis method that combines tongue recognition and tongue diagnosis and questioning. Xia et al [33] on the other hand, first explored the correlation between TCM evidence elements and 39 physical and chemical indicators in 2020 and constructed a multi-label learning algorithm to obtain TCM diagnosis of metabolic syndrome based on the feature that multiple TCM symptoms can occur in the same patient. 2021 Xia et al [34] further integrated 14 physical and chemical indicators and 6 TCM indicators, including chordal pulse, chest tightness, spontaneous sweating The results of their study showed that the metabolic syndrome was predicted based on the fusion of 14 physical and chemical indicators and 6 TCM indicators, including the chordal pulse, chest tightness, and spontaneous sweating. From the results of their study, the model constructed based on the confused indicators has higher specificity, accuracy, and sensitivity than the models of physical and chemical indicators and TCM indicators alone and has better predictive ability.

Future prospects of intelligent research in TCM diagnosis

Traditional TCM rely on culture and imagery thinking, modern technology relies on objective material basis, respects the ontological characteristics of TCM, and incorporates new technologies and methods, such as the application of artificial intelligence speech recognition, commercial trial of 5G communication, development of micro-sensors, virtual reality technology, high-precision sensors, construction of big network big data network platform and self-learning knowledge system, etc., which will contribute to the construction of a new model of TCM diagnosis combining human and machine, which will be an important way to modernize and develop TCM.

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DOI: https://doi.org/10.37191/Mapsci-2582-7367-3(2)-043