Development of Intelligent Medicine and Construction of Intelligent Medical Engineering Specialty

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***Abstract*—Based on clinical big data and artificial intelligence and web technologies, Intelligent Medicine takes form as a medical service model centered on patient data. This paper introduced the development of intelligent medical treatment, analyzed the current application of big data analysis in intelligent medical practice, and looked forward to the challenge and future trend of intelligent medicine. Focusing on the training mode of intelligent medical engineering specialty, this paper explored architecture of intelligent medical engineering education platform, made the construction of a scientific and reasonable interdisciplinary curriculum system in the process of interdisciplinary postgraduate training according to the aim and characteristics of interdisciplinary, hoping to realize a unique new interdisciplinary education mode.**

***Keywords*—intelligent medical treatment, big data, artificial intelligence, intelligent medical engineering, professional construction**

I. Introduction

Big data and artificial intelligence technology have been constantly influencing and changing the traditional medical model and bringing new vitality to the development of medicine. As a science branch characterized by safety, accuracy and effectiveness, modern medicine has confronted many problems, such as large amount of data, low efficiency of diagnosis and treatment process, lack of standardization of medical norms [1]. At present, big data and artificial intelligence technology have been gradually integrated with medicine, providing new ideas and ways for disease diagnosis and treatment. In the future, the continuous integration of technology and application is bound to bring greater impact and change to the future medical model.

The intelligent medical market puts forward new requirements for the medicine. The specialty of intelligent medical engineering is an emerging interdisciplinary subject that meets the national development plan [2]. As a model of emerging medical direction, based on traditional medicine, intelligent medical engineering takes medicine as the skeleton, artificial intelligence technology as the connection point, patients as the core, and gets the support from big data, machine learning, computing technology, and data medical industry, aims to promote the development of medicine and cultivate comprehensive talents for future medicine [3]. Focusing on the training mode of intelligent medical engineering specialty, this paper explores the construction of a scientific and reasonable interdisciplinary curriculum system in the process of interdisciplinary training, and introduces advanced information technology into the training mode according to the characteristics of interdisciplinary, to form a unique new interdisciplinary innovative education mode.

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II. Impact of Big Data and Artificial Intelligence Technology on Medicine

In recent years, big data and artificial intelligence technology have changed people's thinking, lifestyle and working mode from all aspects. The continuous impact of Internet of things, Internet, cloud computing, artificial intelligence and big data technology, has brought new vitality to medical development and medical industry. With the continuous advancement of the national decision-making of "healthy China 2030", health care big data has been gradually regarded as an important basic strategic resource by the country [4]. Industry governance, clinical application, scientific research, public health, management decision-making and industrial development will be the promotion direction of the whole medical field in the future, and provide new ideas and approaches for disease diagnosis and treatment as well as medical research and discovery.

A. Impact of Big Data on Medicine

Generally speaking, medical big data covers the whole life cycle of each individual, involving not only personal health and medical services, but also disease prevention and control, health security, food safety, health care and daily regulation. The main data sources cover hospital diagnosis and treatment, medical product enterprises, medical expense revenue and expenditure and health management [5].

Big data possesses the following four characteristics: volume, variety, velocity, and veracity.

Huge data volume. The medical field and life science have become the field of big data. In 2020, the number of

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diagnosis and treatment people in China reached 7.61 billion, and the resulting amount of data as high as 35ZB, which is 44 times of that in 2009. Meanwhile, the amount of genome sequencing data of a single individual exceeds 100GB, and the transcriptome sequencing data exceeds 30GB [6].

Various data structures. Multiple data types include structured data of databases such as Oracle and MYSQL, semi-structured data of XML documents, and unstructured data such as word and PDF documents, images, audio and video [7].

Fast growth and processing speed. The medical and health big data increases sharply at a rate of 48% every year in recent decade. All kinds of inspection and test results need to be presented to the doctor-patient care and management level [8]. This growing dynamic data and the real-time data generated by the medical Internet of things become more critical of the speed of data processing.

Value density is low but application value high [9]. For example, in the medical image information, there may be only a few layers or frames of information are related to diagnostic and prognostic evaluation compared with hundreds of MB original image data [10]. Only through the integration of artificial intelligence technology and computer technology, can the potential great value behind the data be generated to solve the practical problems in the medical field and realize the secondary development of data.

B. Impact of Artificial Intelligence on Medicine

Artificial intelligence takes cybernetics, information theory and system theory as the theoretical basis, applies mathematical logic and cognitive principles of neuroscience, and simulates the intellectual activities of human brain through logical deduction programming of computer science. The recognized realizable scenario of artificial intelligence technology is to solve the problem of repeatability [11].

For example, an imaging doctor may have to read thousands of images every day, but in such a high-density working environment, limited by doctors' fatigue and emotion, the diagnostic accuracy cannot be ensured all the time, which is one of the pains points that artificial intelligence technology can help solve [12]. In the overall process, icomics system can extract data from medical big data, mine data information combined with artificial intelligence technology, to form clinical auxiliary decision-making [13]. Just as the process of film reading is consistent with that of imaging doctors, that is, collect image data first, and then extract image features using human eyes and clinical experience to form diagnostic opinions, artificial intelligence technology needs to complete this typical intelligent process of pattern recognition, feature extraction, analysis and modeling and image processing.

Artificial intelligence technology should not only simplify the imaging process, but also realize the following three aspects: lesion detection, that is, to judge whether the patient is sick according to the pathological image; Qualitative diagnosis, to judge the benign or malignant lesions and the severity of the disease; Adjuvant therapy decision-making, to give targeted and valuable adjuvant therapy suggestions according to image information.

III. Objectives, Contents and Problem Analysis of Intelligent Medical Engineering Specialty Construction

A. Objectives of Intelligent Medical Engineering Specialty Construction

Taking into account the current needs and long-term development, the research objectives are implemented in three stages. First, two types of hospitals, including general hospitals and community hospitals, are fully investigated and analyzed to understand their characteristics, advantages and disadvantages of personnel demand in the construction of digital hospital and intelligent medical treatment. Second, the training objectives and training programs for intelligent medical application-oriented personnel in colleges and universities are explored, and an intelligent medical training model is established to meet the actual needs. Third, through the cooperation of universities, hospitals and related business institutions, establish the tracking mechanism of intelligent medical treatment and the feedback mechanism of talent training are established as a dynamic talent training mechanism of serving intelligent medical treatment from a long-term perspective [14].

B. Contents of Intelligent Medical Engineering Specialty Construction

Based on the goal of "application-oriented" and serving "intelligent medicine", contents of intelligent medical engineering specialty construction include two aspects: service and technology [15].

Services: (1) Intelligent services for patients and their families, such as appointment registration, intelligent medical guidance, positioning, information query. (2) Intelligent services for medical staff, such as surgical monitoring, nursing call, and prescription management. (3) Intelligent services for hospital management, such as electronic medical record management, financial management, ward management and emergency treatment. (4) Intelligent services for hierarchical diagnosis and treatment and inter hospital cooperation, such as remote treatment, expert remote consultation, referral, etc.

Technology: wireless network technology, sensor technology, storage technology and database technology.

1) Intelligent diagnosis and treatment

Intelligent diagnosis and treatment are to apply artificial intelligence technology to disease diagnosis and treatment. Computers can help doctors make statistics of pathology and physical examination reports. Through big data and deep mining technologies, patients' medical data can be analyzed and mined to automatically identify patients' clinical variables and indicators. The computer simulates the doctor's thinking and diagnostic reasoning

by "learning" relevant professional knowledge, so as to give a reliable diagnosis and treatment plan. Intelligent diagnosis and treatment is the most important and core application scenario of artificial intelligence in the medical field.

2) Intelligent recognition of medical images

In the traditional medical scene, it takes a long time and high investment cost to train excellent medical imaging doctors. In addition, when reading the film manually, it is too subjective and the information is not used enough, so it is easy to misjudge in the process of judgment. According to research statistics, more than 90% of medical data come from medical images, but image diagnosis depends too much on people's subjective consciousness, which is prone to misjudgment. AI can help doctors locate the focus area and reduce the problem of missed diagnosis and misdiagnosis by learning a lot of medical images.

3) Medical robot

Robots are widely used in the medical field, such as intelligent prosthetics, exoskeletons and auxiliary equipment to repair human damaged bodies, and medical care robots to assist medical staff in their work. At present, the research on the application of robots in the medical field mainly focuses on surgical robots, rehabilitation robots, nursing robots and service robots. The domestic medical robot field has also experienced rapid development and entered the market application.

4) Drug intelligent research and development

Relying on the big data information of millions of patients, the artificial intelligence system can quickly and accurately mine and screen suitable drugs. Through computer simulation, artificial intelligence can predict drug activity, safety and side effects, and find the best drug to match the disease. This technology will shorten the drug development cycle, reduce the cost of new drugs and improve the success rate of new drug development.

5) Intelligent health management

Intelligent devices built according to artificial intelligence can monitor some basic physical characteristics of people, such as diet, physical health index, sleep and so on. Carry out simple evaluation on physical quality, provide personalized health management scheme, timely identify the risk of disease, and remind users to pay attention to their own health and safety. At present, the application of artificial intelligence in health management is mainly in risk identification, virtual nurses, mental health, online consultation, health intervention and health management based on precision medicine.

6) Prediction of epidemic diseases

Through massive search data and decision-making judgment system, we can predict the occurrence of epidemic. For example, in 2017, Google used billions of search records to process 450 million different digital models to construct an H1N1 influenza prediction index. The correlation between the results and the official data of the U.S. Centers for Disease Control and Prevention (CDC) was as high as 97%, but it was two weeks ahead of CDC. This "predictive" ability can obviously win the first opportunity for the whole society to control the epidemic situation of infectious diseases in advance.

C. Main Problems to Be Solved in the Construction of Intelligent Medical Engineering Specialty

At present, the biggest problem of AI + medical is the source and quality of data, because there are often information islands between hospitals and between hospitals and families. Even within the same hospital, extracting and using data still involves a lot of manual operations.

The diversity of data is also a major obstacle. Whether it is the treatment of skin diseases or cancer, the image may only be a parameter, and the treatment of diseases requires multiple parameters, which is the biggest concern of doctors. From the perspective of investors, just looking at the image is not enough for them to make a judgment. Investors prefer to solve at least one small problem and make a clinical auxiliary diagnosis.

In addition to the common image recognition and deep learning, there is also a premise for the specific application of AI in medical image diagnosis: how to transform unstructured data into structured data.

The undergraduate course of intelligent medical engineering includes many disciplines such as science, engineering and medicine. The content span is large and difficult. It is a great challenge for students of any single major.

Intelligent medical engineering is an interdisciplinary and comprehensive discipline with strong scalability, which lays increased difficulty for students to deeply understand the whole industry in the learning process, and it is advisable to deal with the problems in the following aspects [16].

1) Professionalism

By strengthening case study and training operation, more emphasis and focus can be laid on the key capability training rather than normal course study. More applicable instruments, facilities and course materials are employed as the interdisciplinary majors require, and the architecture of the curriculum system are more suitable for the profession need.

2) Industry

In the process of student training, the impact of industry development on the major should be enhanced, and the industry needs be closely combined with student training. This kind of traditional cultivation process can reconcile the whole industry with higher education systematically and comprehensively, which integrates the application of artificial intelligence with medicine.

3) Development

Graduates of Intelligent Medical Engineering should reconcile instead of distinguishing themselves from students majoring in electrical, automation and information, and give full play to the characteristics of their major. Therefore, intelligent medical engineering specialty needs to establish a complete training process, including curriculum, experiment, practice and completion, so as to cultivate high-level talents with professionalism, industry and development.

IV. Architecture of Intelligent Medical Engineering Education Platform

The medical big data mainly include 6 categories: personal daily physiological data, genomics and proteomics data, hospital electronic case data and electronic health file data, large cohort study and medical scientific research data, network health data, public health data [17]. At present, the application of medical big data is still in its infancy, and many potential utilization values need to be revealed continuously.

The combination of medical big data and data mining processing technology can help extract valuable information from the stored large and highly complex medical data and accelerate the transformation of medical achievements. The architecture of the medical big data platform is briefly described in Fig. 1. This architecture mainly includes the following four layers.

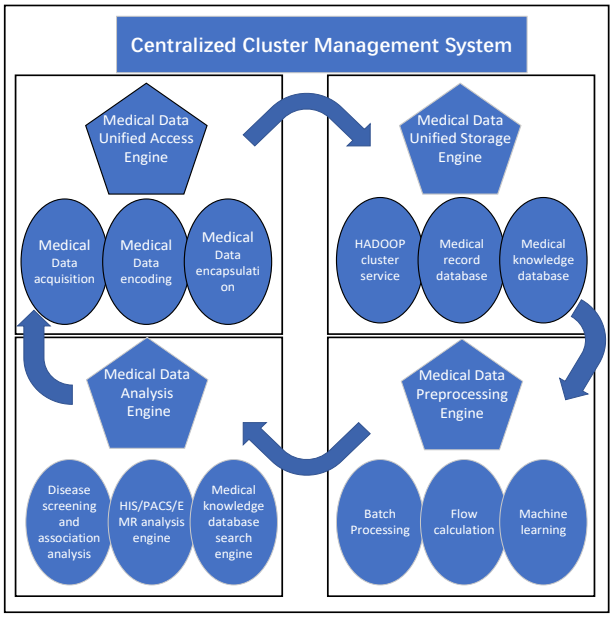

Figure 1. Architecture of medical majority platform.

Medical Data Unified Access Engine: use multiple means to receive data from the resource, and carry out coding and encapsulation processing.

Medical Data Unified Storage Engine: import the data from the front end into a centralized large-scale distributed database, such as Hadoop cluster service and medical knowledge base.

Medical Data processing layer: use big data mining technology to preprocess data to meet most common analysis needs.

Medical Data analysis Engine: carry out calculation and analysis by various algorithms on the existing data to achieve disease screening and intelligent analysis, big data business analysis engine, and medical knowledge base search engine [18].

V. Course Construction of Intelligent Medical Engineering

Intelligent medical engineering is an interdisciplinary subject integrating electrical, medical, computer and other disciplines. Based on big data, machine learning and medicine, by which it develops the data medical industry, creates employment opportunities in industries such as intelligent medical treatment, intelligent elderly care and human-computer interaction, and creates a new economic growth point [11]. This major adheres to the higher education characteristics of "developing both work and study" and concept of "promoting work and serving the country", trains professionals with intelligent medical characteristics, engages in the research, product design and development, and medical technical support services of intelligent medical devices and information systems in medical and health intelligent product manufacturing related industries, medical related research institutes, universities and general hospitals [12].

Integrate curriculum system and systematic curriculum setting are the necessary ensures for the construction of intelligent medical engineering curriculum system. In the course design process, hardware, software, algorithms, medicine and other related courses are designed respectively and cooperatively in accordance with the architecture of intelligent medical engineering education platform, and different parts of each course are combined, such as medical imaging, intelligent medical image processing, deep learning, medical big data mining, medical imaging system and basic medicine courses, so that students can learn both professional courses at the same time, to combine the two disciplines and master the industry background and development direction of intelligent medicine.

The focus has to be laid on integration of theoretical and practical education. Taking medical students as the main training object, the curriculum system strengthens the technical integration related to intelligent medical treatment, such as hospital management system, database technology, network technology. In experimental training, it is highly demanded to appropriately reduce basic experimental courses and increase practical training courses in off campus hospitals. Provide students with a platform for personal practice intelligent medical services in a real medical environment, to find problems and correct them in time.

VI. Conclusion

Intelligent medicine based on big data has been applied and explored in the fields of medical examination, medical image analysis, clinical diagnosis and so on. The advent of Artificial Intelligence era provides new methods for medical testing and clinical diagnosis, and promotes the development of the medical industry. However, the development of intelligent medicine in China is still in its start stage and still faces many challenges.

As a model of emerging medical direction, intelligent medicine engineering reunites the development of artificial intelligence into modern medicine. Through the teaching investigation of intelligent medical engineering students, this paper makes a systematic design and practical planning for the construction of intelligent medical engineering specialty. The training system

integrates the knowledge of different majors of both sides, build an emerging discipline platform that conforms to the development of the times and the needs of employing enterprises, take into account the professional development direction in the macro and the personal development needs in the micro. On the basis of learning traditional medical diagnosis, students majoring in intelligent medical engineering combine artificial intelligence with medicine, explore the application of artificial intelligence technology in the medical field, transform technology into productivity, cooperate to innovate human-computer interaction technology, and integrate big data, cloud computing and clinical patients with the support of emerging technologies, so as to complete the learning task with quality and quantity. Compared with traditional medical staff, intelligent medical engineering professionals are better at using new trend technologies to solve medical problems, creatively help diagnosis and treatment with technologies in the field of artificial intelligence, and enhance the utility and development of medicine.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

This article was prepared by Yi Yang and Dekuang Yu. Both of the authors completed the research design and data analysis. Yi Yang took the lead in writing the article. Dekuang Yu proofread all drafts and gave guidance to the paper, and reviewed the article objectively. Both the authors have contributed to the further revision of this article, and had approved the final version.

Finally, both of the authors have made contributions to the writing and revision of the article, and have some constructive suggestions for improvement to ensure that the article can accurately express the research results.

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