Development, Application and Prospect of Artificial Intelligence in Biomedical Field

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Abstract. The advancement of artificial intelligence, which has remarkable applications in numerous industries, is a key area of worldwide science and technology development. Among them, the application of artificial intelligence in new drug research and development and auxiliary disease diagnosis has made such outstanding achievements. Therefore, this paper analyzes the development and application of AI in biomedicine and looks forward to its future development. The detailed review included examples of how artificial intelligence has been used in biological medicine, the research and development of new pharmaceuticals, the development of new drugs, and the diagnosis of auxiliary diseases. Finally, this paper summarizes and prospects the future development of biomedicine.

Keywords: AI; Biomedical; Drug Discovery; Ai Assist.

1. Introduction

A field that is closely related to engineering technology is biomedicine. Engineering techniques are used in the medical industry to advance medical standards and enable patients to receive better care [1]. It is crucial to raise medical technology and level with the advancement of society and the increase in public health awareness. However, there are still some issues in the actual world, such as a lack of medical workers, protracted research and development cycles for new drugs, and insufficient and imbalanced medical resources [2-3].

Artificial intelligence (AI) is a young field of technological study that investigates and creates theories, procedures, tools, and systems that mimic, amplify, and augment human intelligence. Since its inception, thanks to the work of innumerable researchers, it has not only attained AlphaGo but also demonstrated astounding performance in a variety of other domains [4]. With its strong intelligence, biological medicine is also given new life and opportunities in areas like drug discovery, illness auxiliary diagnostics, medical imaging, and auxiliary treatment. Treatment, health management, clinical decision support, and other professions all have practice cases. The three applications of AI in biomedicine—AI and new drug research and development; AI and adjunct illness diagnostics; and associated opinions on its future development trends—will be the main focus of this essay.

2. Application Exampels of Artificial Intelligence in Biomedicine

2.1 AI and New Drug Development

At present, the R&D of new drugs is faced with the double dilemma of high cost and low yield. New drug R&D is characterized by high technical difficulty, large investment, high R&D risk, high rate of return and long R&D cycle. With the increase of disease complexity, the difficulty and cost of new drug R&D increase rapidly, and the success rate of new drug R&D in the world shows a significant downward trend [5]. In 2019, IQVIA released a report pointing out that the average development time of new drugs from the beginning of clinical trials to the end of research and development has increased by 26% in the past 10 years, reaching 12.5 years in 2018; The success rate of new drug development continues to decline, dropping to 11.4% in 2018. According to the report of Nature magazine, the cost of new drug research and development is growing rapidly, and the

average cost of development in 2018 is about 2.6 billion dollars [6]. The return on investment in new drugs continues to decline. According to the report released by Deloitte, the return on investment in R&D of the top 12 pharmaceutical companies in the world in 2017 was only 3.2%, down 7 percentage points from 10.3% in 2010 [7-10].

Long cycle, high expense, and low success rate are the drawbacks of new medicine R&D. AI technology in conjunction with drug R&D will significantly contribute to increasing productivity and lowering prices. AI research and development of new pharmaceuticals refers to the accurate and speedy mining and screening of acceptable compounds from a huge number of compounds for the discovery of new drugs. This is done through the use of big data analysis, in-depth learning technologies, and other ways. The cost of developing new drugs is reduced, the research and development cycle is greatly shortened, and the economic climate and the success rate of developing new drugs are all improved.

Drugs need to effectively act on human target cells and conduct targeted therapy, and this process can benefit from computer-aided drug design (CADD) [10]. CADD can combine biochemical space to obtain effective and safe drugs, avoid toxicity and complete drug development. In the process of drug development, AI and big data establish an automatic model to analyze the three-dimensional structure of cells and proteins, as well as the interaction of drug receptors, ADMET characteristics detection, etc. through preprocessing data, artificial intelligence algorithms, and statistical applications. Data Fig. 1 shows the pre-processing and modeling. Redundancy feature elimination, outlier detection, and missing data filling are all steps of data preprocessing. After data preprocessing, can use supervised learning and unsupervised learning to model.

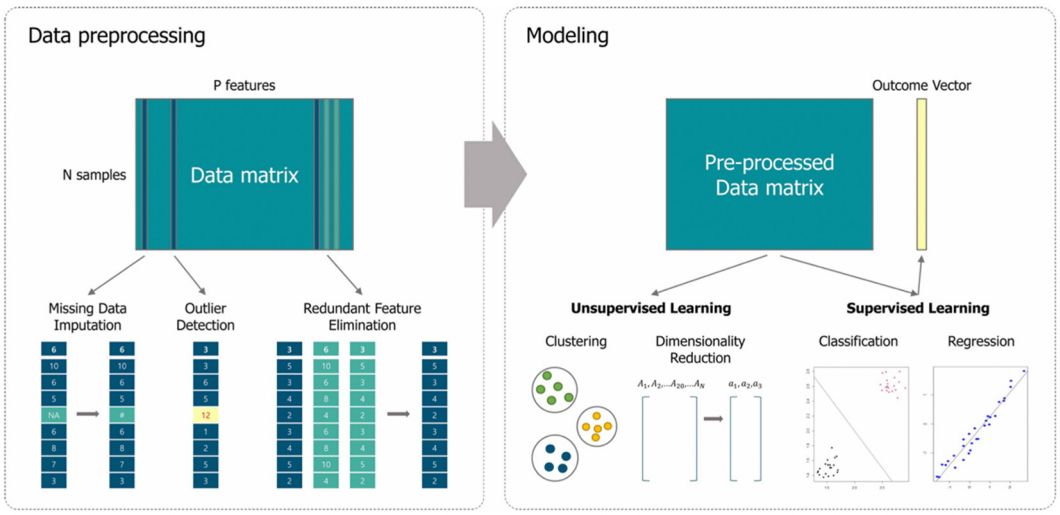

Fig 1. Data pre-processing and modeling.

The concentrated expression of drug discovery and development becomes the data value in the data set, which includes some abnormal data, namely outliers. These data values often lead to experimental failure. Therefore, it is necessary to exclude outliers before establishing the model. One of the software programs called Alchemite can not only remove outliers, but also complete some missing data, and automatically detect extreme values that do not conform to the data pattern. This has greatly improved the quality and speed of drug research and development.

Consider BergHealth as an illustration of how AI is being used in the creation of new drugs. When developing new models for medication development and study in cutting-edge domains, BergHealth, a data-driven biological research organization, makes use of big data. Unlike the conventional biological hypothesis, this model is based on biological evidence and offers a workable technique to investigate how the metabolism changes in disorders. It has gathered extensive knowledge in neurological and lipid metabolism illnesses [8]. The drug R&D platform is really concerned with how to create a patient map. Big data analysis, genomics, proteomics, metabonomics, and the Yuantai

biological model are all combined in the company's platform to extract valuable data and improve the efficiency of drug research and development.

AI can be predicted by computer simulation in the area of drug activity, safety and vegetable 2 force, which are of great concern. With the aid of extensive learning, AI is currently making strides and breaking new ground in the fields of anti-arsenic tumor therapies, cardiovascular drugs, and drugs for commonly occurring infectious diseases.

2.2 AI and Auxiliary Disease Diagnosis

Future medical staff shortfalls will be resolved through intelligent medical therapy. Human doctors must through a lengthy, extremely rigorous training process that costs a lot of money. It might not be possible to become an extremely good doctor in clinical settings even after more than ten years of education [9]. Additionally, a lot of experience is needed. Artificial intelligence is different. With the accelerating pace of computing and the development of algorithms, it is now possible to quickly provide guidance on some infectious ailments in modern medicine, identifying which illnesses require further study, which tests should be performed, and which locations should be taken into consideration. In turn, smart medicine can successfully address the issue of insufficient doctor resources and offer year-round medical care wherever in the world. More data and more terminals are two characteristics of the age of intelligent medical therapy. Intelligent medical treatment can make it possible for household medical equipment and sensor devices to automatically or self-assist collect a variety of physical sign data about human existence [10]. The system can simultaneously integrate current hospital, out-of-hospital, and gene medical data, achieve wide data sharing and deep data use, and offer long-term, quick stable health monitoring, diagnosis, and treatment services.

For a treatment to be successful, a pathology diagnosis of high caliber is a crucial requirement. However, the current state of affairs necessitates significant personnel costs for routine case diagnosis. But quality assurance falls short of expectations. Such methods can greatly increase the precision of diagnosis and treatment, which is the aim of intelligent assistant diagnosis and therapy. Artificial intelligence (AI)-based pathological diagnosis is primarily used to replicate doctors' thinking, comprehension of pathology, and manner of diagnosis process as well as to continually learn from the medical knowledge and experience of doctors and specialists.

The most sophisticated AI tool in the worldwide medical industry is IBM Watson. Clinicians can input critical patient indications into Watson, which can then instantly compare thousands of publications and research archives in the massive data repository, including hundreds of medical professional journals, oncology monographs, and thousands of papers. By deeply integrating technologies such as natural language processing, cognitive technology, white motion reasoning, machine learning, and others, the system's primary objective is to provide broad evidence gathering, analysis, and evaluation as well as sub hypothesis cognition. Auxiliary physician Watson began working in a number of American hospitals in 2012 after passing the American Professional Physician Qualification Examination. At the moment, Watson is able to provide diagnostic services for conditions like ovarian cancer, prostate cancer, lung cancer, breast cancer, and colon cancer.

In other aspects, there are similar cases of AI diagnosis for humans. The AI software developed by American researchers can directly translate the patient's image results into diagnostic information, which is fast and accurate. It can assist doctors rapidly and precisely evaluate the risk of breast cancer and accurately interpret the mammography results. An article about this accomplishment appeared in the worldwide scholarly journal Cancer [11].

In the 1970s, China also developed an expert diagnosis and treatment system. For example, in order to simulate the procedures of the old Chinese doctor Youbo Guan in diagnosing and treating liver diseases, Beijing College of Traditional Chinese Medicine developed a medical expert system for Youbo Guan’s hepatitis to assist in diagnosis and treatment. Early in the 1980s, Rugao Lin’s bones were diagnosed and treated using a computerized system created by Fujian College of Traditional Chinese Medicine and Fujian Computer Center. Other colleges and universities have created AI-

based medical computer expert statistics that have been successfully used in clinical practice, including Xiamen University and other research organizations.

As was already noted, the application of AI for disease detection primarily depends on its analysis and processing of enormous data, which is also the reason it can be out of proportion among many scientific initiatives.

3. Development Prospect of Artificial Intelligence Application in Biomedicine

The rise of artificial intelligence has given researchers and developers of new drugs additional technical tools. The effectiveness of novel drug research and development has been considerably enhanced through machine learning (ML), deep learning (DL), and other techniques to enable drug target identification, compound screening, and other links, enabling the possibility of cost reduction and efficiency enhancement. Applying AI technology can reduce the time required for early research and development by almost half, boost the success rate of new medication research and development from 12% to 14%, and reduce the cost of compound screening and clinical trials by around $55 billion annually worldwide.

Table 1. Common application algorithms of artificial intelligence

AI technology	AI Type	Algorithm Characteristics
Machine Learning(ML)	Decision Tree	Decision tree is a ML method that clearly represents the decision process in a tree structure. Essentially, it is a process of classifying data through a series of rules
	Random Forest	A classifier called random forest creates several decision trees to train and predict samples. The mode of the category output by each decision tree determines the final output category.
	Support vector Machine	Support vector machines are employed more often for classification issues than for regression ones, yet they can handle high-dimensional variables in small data sets.
	K-Nearest Neighbor Algorithm	K-nearest neighbor algorithm is an unsupervised learning algorithm for classification and regression. It is a mature method in theory and one of the simplest ML algorithms.
	Naive Bayes Classifier	Naive Bayes classifier is one of the most heroic and extensive classification algorithms. Only a small amount of training data is needed to estimate some necessary parameters, which can achieve good results in many complex conditions.
Deep Learning(DL)	DNN	DNN consists of an input layer, a hidden layer and an output layer. Each layer contains several neurons. It is one of the earliest DL algorithms used in drug discovery.
	RNN	Molecular linear input strings, time series data, gene and protein sequence data, and other sequence data are all processed using RNNs, a type of neural network (SMILES). Since it has shared parameters and memory, it has some advantages when learning the nonlinear properties of sequences.
	CNN	CNN is a feedforward neural network, which has excellent performance in the field of image recognition.
	AE	AE is a neural network used for unsupervised learning, which has a very good ability to extract data feature representation. Its typical use is applicable to data dimensionality reduction. It is an important part of deep confidence network, and has a wide range of applications in machine translation.

AI technology covers ML and DL as shown in the table ML algorithm is widely used in classification and regression prediction in the field of new drug research and development. Common ML algorithms include decision tree, random forest, support vector machine, k-nearest neighbor algorithm, naive Bayes classifier, etc.; DL algorithm includes deep neural network (DNN),

convolutional neural network (CNN), recurrent neural network (RNN) and auto encoder (AE). DL algorithm is suitable for processing big data, and the model is more complex. With the improvement of computer performance and the accumulation of data, DL algorithm is more and more widely used in the research and development of new drugs.

DNN is one of the earliest DL algorithms used in drug discovery, which originated from the calculation model proposed by McCulloch et al. in 1943. CNN is a kind of feedforward neural network, which has excellent performance in the field of image recognition. RNN is a kind of neural network used to process sequence data [12]. It has memory ability and can be used to process gene and protein sequence data. The purpose of self-encoder is to reconstruct input data and generate learning model, which has broad application prospects in drug molecule generation. DL algorithm models such as DNN, CNN and RNN predict the physicochemical properties of drug molecules and the absorption, distribution, metabolism, excretion and toxicity (ADMET) of drugs through quantitative structure property relationship (QSPR) or quantitative structure activity relationship (QSAR).

Although AI is at a stage of rapid development, there are still three problems to be solved in order to make AI work better in the biomedical field.

- **How to obtain high-quality data.**

The amount of data samples that can currently be acquired using AI is limited. How to fairly arrange the quantity and caliber of data samples to guarantee machine learning's efficacy, which is directly related to the impact of machine learning an essential precondition is learning how to acquire high-quality clinical data, which is more suited for the application of AI in the medical sector. Comprehensive data collection can provide information about which hospital to operate in, as well as the doctors. In the UK, for example, the National Institute for Excellence in Health and Nursing (NICE) developed an intervention program plan in 2002. The guidelines can specify which doctors can participate in the surgery and guide the future use of the evidence needed to protect the safety of patients [13]. However, comprehensive data collection is also difficult after implementation. Clinicians lack enthusiasm, and hospitals may not realize the importance of supporting data submission, as well as the complexity of some transnational case data collection. However, the following measures can be implemented in the foreseeable future. Equipment tracking: use the equipment to track the medical treatment of a single patient, and regularly update the data. The second is the coding program. Turning to SNOMED (medical systematic nomenclature) can help achieve comprehensive data collection. The use of registers and the use of registers by hospitals can better manage and collect data, thereby reducing the collection of erroneous data and obtaining high-quality data. The promotion of international cooperation has promoted data sharing in different countries and may help stimulate similar initiatives elsewhere.

- **How to protect patients' personal privacy to a greater extent.**

When creating patient files and initializing patient medical and healthcare plans, the privacy of patients should be taken into account. The following links describe methods to perform more effective confidential treatment that can safeguard patient privacy without hurting the use of data and the creation of models. Topics covered include file storage, file transmission, file access, and open conversation. The answer to this query must be taken into account when building intelligent medical databases. Facing the threat of big data, in order to ensure data security, there are some methods, such as improving cloud computing algorithms, improving cloud service quality, improving management technical means, and setting up laws and regulations. It is very necessary to improve the cloud algorithm of cloud services. With the development of the big data era, more and more people store data on cloud servers [14]. Therefore, users should filter the quality of cloud services. Companies providing cloud services should strengthen the algorithms of cloud storage servers and strengthen the detection and protection against malicious intrusion, so as to reduce data leakage or hacker intrusion in cloud storage servers. Data can be managed and controlled at different levels, and data can be divided into different important levels to achieve different degrees of security protection. The data

flow among the third-party systems is shown in Figure 2. When data is transferred across clients, our security model views this as the most serious threat to cloud data secrecy. In this instance, the model protects data confidentiality by securely transferring cloud data and identifying bad actors who leak data, hence lowering the likelihood of data leaking.

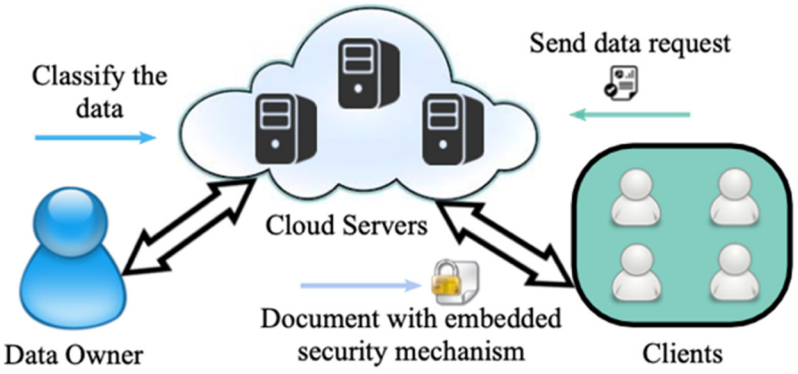

Fig 2. System mode.

In the face of hacker intrusion, its personnel can upgrade the attack detection of unauthorized request loading in the process of application development to identify and remind users of risks. The device can effectively detect known and unknown malware, greatly reduce the probability of personal data leakage, and enable users to improve prevention awareness.

- **How to make people trust the role of AI in biological medicine more.**

People who have been shaped by their conventional beliefs for a long time would not always accept a disease's diagnosis based on A's data. No matter how clever the cushion is, it cannot replace people's compassion and feelings, and it can be challenging to comprehend the patient's emotions. These are in fact very weak in comparison to doctors. For example, in China, many hospitals have introduced the use of mechanical arms to inject patients. According to the survey, many patients have a skeptical attitude towards robot injection and are afraid of it. In comparison, more than 80% of people prefer doctors to give them injections, rather than robots. Patients frequently cannot be treated, but alleviation and comfort are still necessary, which is part of the doctor's responsibility and shows the doctor's respect for life [15]. According to Doctor Trudeau's objective evaluation of clinical medicine, it also represents the physician's humanistic care and noble sentiments for patients: "Sometimes cured, often alleviated, always soothed." It is difficult for intelligent medicine to discover a quick fix for the problem of human-computer care, nevertheless. It takes time for AI medicine to become hip enough. Doctors' emotional involvement is necessary for patient communication, disease management, and postoperative care. Patient comfort and care provided by intelligent medicine are now inaccessible during doctor interviews. When patients visit offline hospitals, they frequently inquire about their illnesses with the doctor. Is it soon going to get better? Actually, the main focus is on finding psychological solace. Patients still heavily rely on doctors because they tend to provide psychological counseling as the majority of their answers. This significantly illustrates the fact that not all biomedical applications of AI are appropriate. As a result, there may still be a long way to go before AI medical treatment can be used to diagnose and treat diseases.

4. Conclusion

This essay examines how artificial intelligence is being used to generate new treatments and diagnose illnesses. Comparing the benefits of various computation techniques used in medicine. It also examines how to gather high-quality data, how to better protect patients' privacy, and how to increase public confidence in artificial intelligence's role in biological care. If many countries give

artificial intelligence (AI) greater consideration, all facets of the overall administration of the medical health process will become more and more intelligent, and the associated new drug research and development, precision medicine, etc. will become more and more targeted. These technological developments include wearable technology, big data, mobile Internet, Internet of Things, and artificial intelligence. With the development of medical robots, it is projected that AI will do many basic jobs in the future of medicine, providing doctors more time and energy to deliver top-notch patient care. converse while performing cutting-edge medical work. We need to increase investment and R&D activity in the creation and development of databases, algorithms, and general technologies despite the fact that there are a lot of smart medical startups. This will allow AI to have a wider range of applications in addition to a solid technical foundation in the field of biomedicine.

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