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Case Study of Next-Generation Artificial Intelligence in Medical Image Diagnosis Based on Cloud Computing

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Abstract: ***Cloud computing technology is a computing model based on the Internet, which can provide elastic, scalable, reliable and secure computing, storage and network resources to meet the various computing needs of enterprises and individuals. Cloud computing technology has become an important driving force for enterprise digital transformation and innovation. Through cloud computing technology, enterprises can run their business more efficiently, reduce costs, increase productivity, protect data and systems from attacks and leaks, keep systems always available, open new markets, and more. At the same time, cloud computing technology has also brought more innovation opportunities, such as artificial intelligence, big data and the Internet of Things, so as to help enterprises better meet customer needs and explore new markets. In addition, cloud computing combined with artificial intelligence has brought a lot of convenience to many traditional industries, such as medical care, education, and scientific research. By lowering barriers to entry, cloud computing levels the playing field and makes it easier for these businesses to compete with established players. With the wide application of technologies such as 5G, artificial intelligence, big data and the Internet of Things, cloud computing infrastructure will become more popular and powerful, but also face more challenges and opportunities. We need to constantly pay attention to the evolution trend of cloud computing and actively respond to new challenges and opportunities, so as to better use cloud computing technology to promote the development and innovation of enterprises and achieve sustainable development. In this paper, by analyzing the practical application cases of the next generation intelligence combined with cloud computing to the medical image analysis and diagnosis industry, the future prospects of cloud computing and next generation artificial intelligence are expounded.***

Keywords: Cloud computing; Next generation intelligence; Medical imaging; Diagnostic detection

1. INTRODUCTION

Cloud virtualization is a computer technology that allows a single physical computer to host multiple isolated operating systems and applications by creating multiple virtual environments on physical computer resources. This technology can make more efficient use of computer resources, improve the reliability and security of the system, and then after years of research and development under the leadership of a research team led by J.C.R. Licklider, finally succeeded in building ARPANET, the predecessor of the Internet, allowing users to access information and applications from remote computers. Became the first computer network and laid the foundation for the later development of cloud computing, thus launching the Internet era.

The Unix operating system was later used as the base operating system for Cloud computing by many Internet service providers, such as Amazon Web Services (AWS), Google Cloud Platform, and Microsoft Azure. At this point, the three underlying technologies of cloud computing were born. At present, cloud computing has become a necessary means of digital transformation and upgrading of enterprises, and more cloud-native technologies and industry-specific cloud solutions have emerged[1-5]. Cloud security, hybrid cloud, multi-cloud and other topics have gradually become hot topics. With the continuous development and popularization of cloud computing technology, cloud native technology has gradually become a trend. In the future, cloud computing and cloud-native technologies will be widely used in various fields, bringing more opportunities and challenges. Cloud computing has come a long way in a short period of time and it has changed the way businesses operate. With cloud computing, businesses now have access to powerful computer resources without investing in their own

hardware. This gives them a major competitive advantage as they can quickly and easily scale their business without having to make large upfront investments.

However, the evolution of cloud computing technology has also completed the transformation from the resource perspective (cloud computing) to the application perspective (cloud native). In industries that are leading the way in digital transformation, such as the Internet and telecommunications industries, cloud native technologies are widely used, and countless new applications support today's convenient work and life.

In today's information age, cloud computing and next-generation smart technologies have become key drivers of rapid development in many industries[6-9]. From finance to manufacturing, from retail to education, the convergence of cloud computing and artificial intelligence is changing business models and the way they operate. This trend not only leads to more efficient data management and processing capabilities, but also provides enterprises with more intelligent decision support and service optimization. In this environment, medical imaging diagnosis, as a key medical service field, has also begun to actively explore and apply cloud computing and next-generation intelligent technologies to improve diagnostic efficiency and accuracy, so as to provide better medical experience for patients.

Especially in the field of medical imaging diagnosis, the combination of cloud computing and next-generation intelligence presents great potential and advantages. Through the powerful computing and storage capabilities of the cloud computing platform, as well as the advancement of the next generation of intelligent technology, medical image diagnosis can not only achieve faster image processing and analysis, but also provide more accurate diagnostic results[10][11]. At the same time, cloud-based intelligent algorithms and models can realize the sharing and collaboration of multi-center data, further improving the reliability and comprehensiveness of diagnosis. This trend in medical imaging diagnostics represents a huge opportunity for the healthcare industry, as well as more reliable and efficient care for patients.

2. RELATED WORK

2.1 The challenges of artificial intelligence in medical imaging

Challenge 1: The number of training samples is seriously insufficient. For the medical imaging field, there are very few standardized public image datasets for AI to learn from. Although some researchers want to create their own medical imaging training sets, the process is difficult. On the one hand, in order to protect the privacy of patients, the department cannot provide samples[12-13]; On the other hand, clinical medical images are relatively complex. If researchers want to obtain data sets from medical image samples obtained from different hospitals, different instruments, different parameters and different angles that can enable the machine to learn correctly, they must pass strict steps such as admission, screening, cleaning and labeling, which requires a huge workload.

Challenge 2: The collection and labeling of clinical medical data is a daunting task. Although hospitals have centralized storage of clinical image data, it is very time-consuming to collect data of a certain type of disease from massive image data. If a unified database can be established according to disease classification, the data collection efficiency can be greatly improved, and the development of scientific research can be greatly promoted. The annotation of medical images is the most difficult task, and the annotation of medical images must be completed by doctors with professional knowledge and authority[14-18]. The labor cost is extremely high, and high-quality annotation is a prerequisite for the good training effect of artificial intelligence.

Challenge 3: Clinicians and patients have low trust in AI to deliver results. For doctors to diagnose diseases, it is important to rely on scientific thinking and clinical experience. This kind of thinking mode, which is not completely fixed, is difficult to replicate in artificial intelligence, not to mention the treatment decisions made by doctors based on clinical diagnosis, which is a comprehensive consideration that integrates scientific basis and humanistic care. Ai learning models rarely take into account doctors' workflows and thinking patterns. Therefore, at present, artificial intelligence is mostly used as a tool to assist doctors in diagnosis, and can not be completely independent diagnosis.

2.2 Cloud computing and next generation artificial intelligence

Cloud Computing (Cloud Computing) is a mode of providing computing services, storage services, database services and other resources through the Internet (or private network). This model is usually provided on demand and paid according to usage. The goal of cloud computing is to enable more efficient and flexible computing services by sharing a pool of resources.

Features of cloud computing include:

Online collaboration: Users can collaborate online to quickly build work scenes and carry out research and development work.

Elastic allocation:[19] Users can dynamically adjust computing and storage resources to meet service requirements.

On-demand self-service: Users can obtain and manage computing resources on demand without directly interacting with the service provider.

Resource sharing: Multiple users can share the hardware and software infrastructure of the cloud computing service provider to achieve efficient use of resources.

Measurement Services: Cloud service providers are able to monitor, measure, and report on users' resource usage so that they can be billed based on actual usage.

Smart medicine is a new medical service model, whose core carrier is patient information, mainly including data, knowledge discovery, remote diagnosis and treatment obtained by hospitals in all aspects of medical service. In smart medical treatment, data acquisition and knowledge discovery rely on the powerful data processing capability of cloud computing, cloud services and intelligent terminals cooperate to provide remote diagnosis and treatment services, and through the alternating operation of various stages, a cycle of "sense, knowledge and action" is finally formed inside smart medical treatment[20-23]. In view of the above advantages of cloud computing technology, after medical service applications are deployed on the cloud, dynamic elastic expansion can be achieved according to the number of visits, and medical services will not be unable to run due to excessive system load. At the same time, the cloud service can effectively save a lot of hardware resource procurement and operation and maintenance costs, reduce the physical redundancy of hardware. In the event of natural disasters, hacking and other unexpected situations, the powerful disaster recovery capability of cloud computing technology can effectively protect the medical data stored in the cloud.

2.3 The application of cloud computing technology in the smart medical industry

(1) Information management

Cloud computing technology has been widely and directly applied in the hospital information management platform, and its working mechanism is mainly to organically integrate the medical software of different departments, so that medical information and medical data can be more convenient to operate and circulate. With the help of cloud computing technology, the hospital information management department can quickly query the medical information of various departments, sort out relevant data in time and find potential problems, so as to make continuous improvement[24]. In addition, the promotion of hospital information management platform can avoid the loss and damage of paper medical records and materials under the traditional medical model, and achieve paperless office.

(2) Prediction and analysis of diseases

With the continuous development of industrialization, the social environment and the natural environment have undergone great changes. Many known viruses have mutated, derived new strains of the virus, a variety of diseases emerge in endlessly, many ways of transmission, spread widely, and the cure rate is relatively low. Once a large-scale outbreak of a certain disease occurs, it will inevitably lead to serious impact on the life, health and economic development of patients in the region. The data center based on cloud computing technology has strong computing capacity, can accommodate large data scale, and can provide comprehensive, accurate and reliable

computing services. The data can be decomposed, processed and analyzed in detail according to the needs of medical personnel[25];

(3) Telemedicine services

In the medical and health field, doctors usually need to make a diagnosis by combining the outpatient situation and the results of various medical images (such as ultrasound, X-ray, CT, MRI, etc.). In the process of medical treatment, patients may seek treatment in multiple hospitals due to many factors, and the format of examination data results between hospitals may be inconsistent[26]. When patients seek medical treatment across hospitals, not only the procedures are very complicated, but also the problem of incomplete examination and diagnostic data is easy to occur, which affects the diagnostic efficiency and accuracy of doctors.

(4) Storing and processing medical big data

At present, the database storage technology widely used in hospitals has been unable to handle the rapid growth and abundant medical data information. Compared with traditional database storage technologies, the cloud storage technology has advantages such as large capacity, high throughput efficiency, and fast read and write speed. Combined with redundant storage policies, the cloud storage technology can ensure the security and stability of related system data[27]. For image data, cloud storage technology can not only break through the data storage limitations of traditional technical means, but also store medical image data with a data volume of petabyte, which is convenient for doctors to view patients' medical images through electronic devices in a very short time, and effectively reduce the misdiagnosis rate while quickly mastering the condition.

3. METHODOLOGY

3.1 Application of AI technology based on CT images in lung cancer treatment

1. Non-invasive prediction of gene molecules

With the development of targeted therapy and immunotherapy, the treatment of lung cancer has entered the era of precision medicine. Identifying gene mutations and molecular expression status is a critical step in determining treatment options. However, current polymerase chain reaction (PCR) and next generation sequencing (NGS) for genetic testing, as well as immunohistochemistry (IHC) for molecular testing, require obtaining tissue, a process that is invasive and relatively expensive[28]. However, the introduction of radiogenomics helps to analyze the associations between microscopic molecules and macroscopic image features, predicting molecular states in a non-invasive manner.

2. Evaluation of treatment effect

Standard treatment for lung cancer includes surgery, chemotherapy, radiation, targeted therapy, and immunotherapy. Artificial intelligence technology is widely used to screen people for treatment benefit and predict clinical outcomes. The prognosis of surgical patients varies greatly, and artificial intelligence offers a novel way to assess prognosis. Cox models based on preoperative PET/CT features and clinical features can effectively predict disease-free survival (DFS) in patients with non-small cell lung cancer undergoing surgical treatment.

3. Survival prognosis prediction

The prognosis of lung cancer patients is affected by many complex factors, and imaging features have become a non-invasive biomarker. Imaging omics can extract quantitative image features from CT images of lung cancer patients to predict prognosis. In addition, deep learning networks can extract prognostic features from CT images of patients undergoing radiation therapy to achieve prognostic prediction of postoperative patients. These models divide patients into low-risk and high-risk groups to guide next steps in treatment. The activation mapping heat map generated by the model can show the contribution of both internal and external tumor regions to prognostic features in CT images, indicating the importance of imaging features in the risk stratification of patients' prognosis.

3.2 practical case

In the early stage of COVID-19, due to the small sample size of confirmed cases and the lack of high-quality clinical diagnostic data in medical institutions, nucleic acid testing as etiological evidence has been recognized as the main reference standard for the diagnosis of COVID-19. With the accumulation of clinical diagnostic data, the imaging big data characteristics of COVID-19 are gradually clear, and the diagnostic results of CT images are becoming more and more important. According to the fifth version of the diagnosis and treatment plan released by the National Health Commission, clinical diagnosis does not need to rely on nucleic acid test results, and clinical diagnosis results of CT images can be used as the standard for judging COVID-19 cases

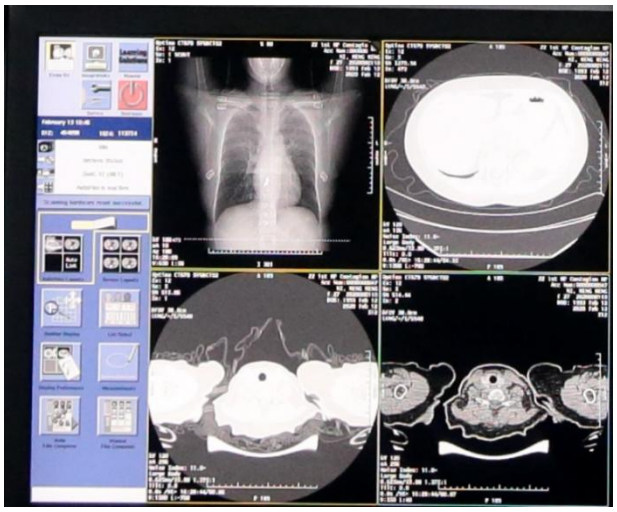

Figure 1: AI automatically identifies CT chest images of COVID-19 cases

CT chest radiographs of patients with COVID-19 are characterized by subtle changes such as multiple, patchy or segmental ground glass density shadows in one or both lungs. By processing retrospective data with NLP natural language and using CNN convolutional neural network to train the recognition network of CT images, AI can quickly identify the difference between COVID-19[29] images and common viral pneumonia images, and the final recognition accuracy rate is as high as 96%. It takes less than 20 seconds on average for AI to identify each case, greatly improving the efficiency of diagnosis and reducing the pressure on doctors. In addition, AI can also directly calculate the proportion of the lesion site, and then quantify the severity of the disease, greatly improving the efficiency of clinical diagnosis.

3.3 Cloud computing helps diagnose COVID-19

Chest radiography and chest CT are important means for screening, diagnosis and disease assessment of COVID-19. Chest radiograph (CXR) is very simple, economical and popular, and is the preferred means of screening and diagnosis of various types of pneumonia, including bacterial and viral. The development of artificial intelligence (AI) diagnostic system based on chest radiograph can provide a more economical and easy to quickly spread diagnostic tool for COVID-19.

Because the lesions shown by X-ray are not as clear and comprehensive as those shown by CT, and the image features of non-viral pneumonia and other viral pneumonia are similar in chest radiographs, the development of artificial intelligence (AI) diagnostic system based on chest radiographs requires a large amount of training data and more clever artificial intelligence algorithms and processes. Previous AI models have been based on weakly supervised classification or attention-based convolutional neural networks for lung disease detection by CXR. However, there is still a lack of fully automated analytical processes that are robust to variable CXR image conditions and that meet the criteria for practical clinical applications.

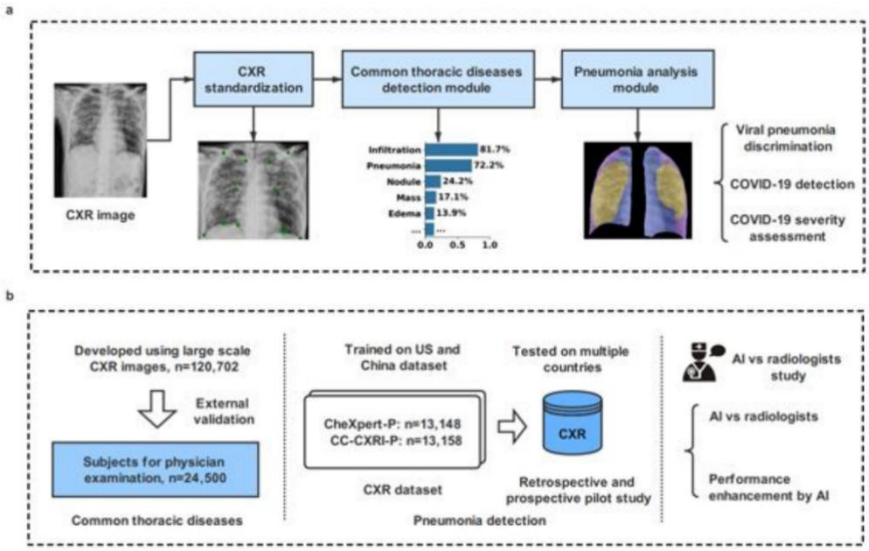

Figure 2: Research achievements of using artificial intelligence in chest X-ray diagnosis of novel coronavirus pneumonia

Using a multicentre dataset containing 145,202 CXR images, as well as thousands of images from four other cohorts and multiple countries for retrospective and prospective testing (Figure 2), the study established a CXR-based image standardization, lesion visualization, and disease diagnosis that can be used to identify COVID-19. This artificial intelligence system is applicable to a variety of environments. It can realize CXR image standardization by introducing automatic anatomical boundary detection into the process, and at the same time provide guidance for automatic learning and analysis of imaging features of various pneumonia. It not only has strong universality, but also has a high degree of universality. It was also good at distinguishing quickly between viral pneumonia, other types of pneumonia and non-pneumonia (AUC=0.88-0.99), severe and mild COVID-19 re-covid pneumonia (AUC=0.87), severe/mild COVID-19 pneumonia, and other viral and non-viral pneumonia (AUC=0.82-0.98). In a separate 440 CXR test, the AI system's diagnostic performance was comparable to that of senior radiologists and was able to significantly improve the diagnostic performance of primary radiologists.

4. CONCLUSION

In conclusion, the integration of cloud computing and next-generation artificial intelligence has significantly advanced medical image analysis and diagnosis, particularly in the field of lung cancer treatment and COVID-19 diagnosis. Through the application of AI technology based on CT images, various aspects of lung cancer treatment have been improved, including non-invasive prediction of gene molecules, evaluation of treatment effect, and survival prognosis prediction. Additionally, practical cases have demonstrated the effectiveness of AI in diagnosing COVID-19 through the analysis of chest radiographs, enhancing the efficiency and accuracy of diagnosis.

Looking ahead, the future of cloud computing and next-generation artificial intelligence in the medical imaging diagnosis field is promising. However, several challenges must be addressed, including data privacy, security concerns, and compliance with regulations and laws. Furthermore, continued research and development efforts are needed to further refine AI algorithms and ensure their reliability and effectiveness in clinical settings.
Overall, cloud computing and next-generation artificial intelligence hold tremendous potential to revolutionize medical imaging diagnosis, offering improved diagnostic capabilities, faster turnaround times, and enhanced patient care. As these technologies continue to evolve, it is essential for healthcare providers and policymakers to collaborate closely to address challenges and leverage opportunities for the betterment of healthcare delivery and patient outcomes.

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