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Review article

Artificial Intelligence for Global Healthcare Systems

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ABSTRACT

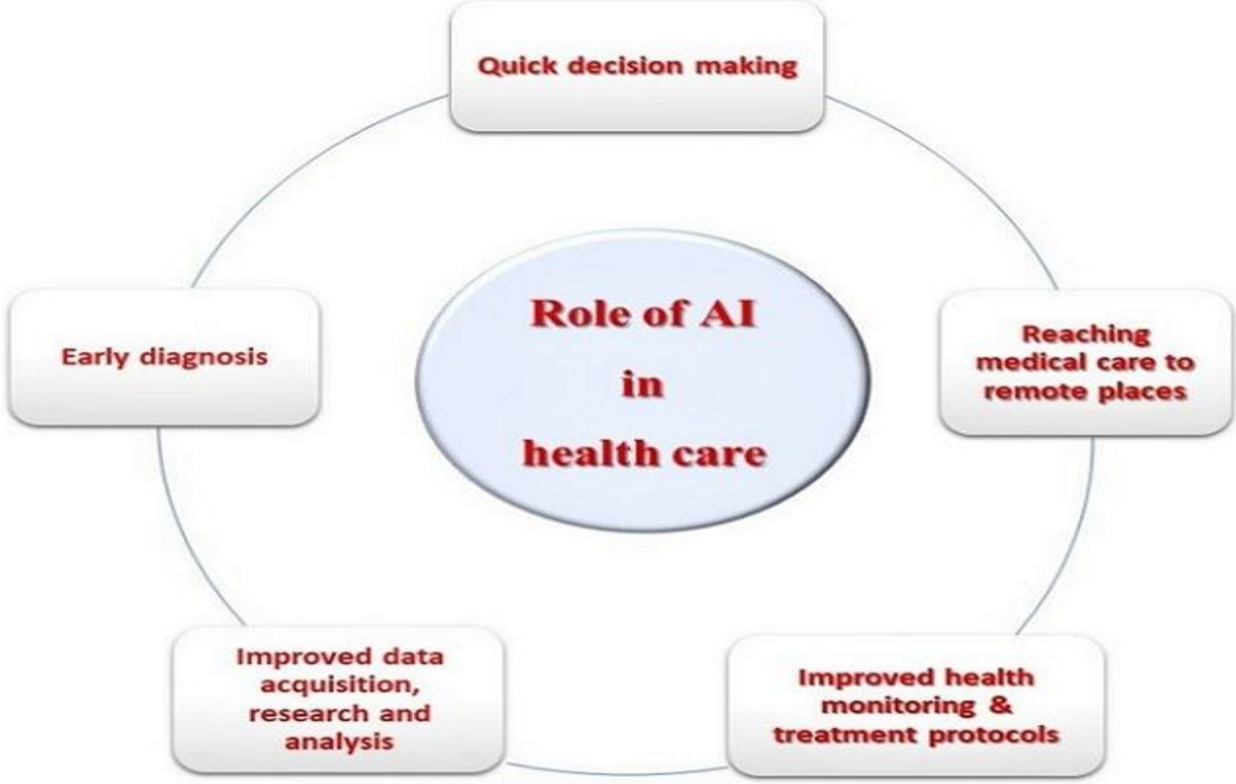
Artificial intelligence (AI) is becoming more and more common in contemporary business and daily life, and it is being used in healthcare settings more and more. AI can assist healthcare professionals in a variety of clinical duties, such as patient care and administration. That being said, they may support in a variety of ways. It won't be long until AI takes the place of humans in a variety of medical professions, despite several articles on AI in healthcare suggesting that AI can perform as well as or better than humans at certain jobs, like detecting illness. The uses of modern computer technologies in various medical contexts is reviewed in this article.

Keywords: Advanced robotics, Artificial neural networks, Bioinformatics, Health care systems, Computerized protocols.

INTRODUCTION

Computer systems designed to think and behave like humans, including learning and problem-solving, use artificial intelligence (AI) to mimic the workings of the human mind. Decision-making, communication, and visual perception are all tasks that require human intelligence. When doctors are asked what the most important elements are for providing exceptional patient care, AI ought to be able to handle these tasks. The doctor's expertise and experience can determine whether or not they can give better patient care. This usually happens gradually, with doctors learning from their experiences and extending their expertise in their areas of interest through ongoing research, all while providing patient care. Understanding artificial intelligence (AI) and its effects on medicine depends on this idea of experience and knowledge. We are better able to make knowledge-based decisions the more experience and data (information analysis) we have. Evidence-based medical sources, including peer-reviewed publications and textbooks, can be used to obtain data. However, experience is gained through actual patient outcomes and results, such as test results, clinical conclusions, and patient files. The primary obstacle preventing the human mind from processing large volumes of information is time limits. Acquiring knowledge requires a combination of experience and knowledge gained over time. Large volumes of patient data may be recorded, accessed, and stored for processing in the age of silicon chips. The fundamental principle of artificial intelligence is utilizing vast data sets and modifying them to acquire expertise. [1] In [comparison to human subjects, computer software may acquire a significantly greater amount of expertise in a shorter amount of time through algorithms. After 40 years of practice, a radiologist will examine about 225,000 MRI/CT scans. By comparison, AI can commence with this quantity and expeditiously expand to millions of scans, augmenting accuracy to a great extent. Therefore, compared to a regular human, AI should be able to analyze and diagnose CT scans far more quickly and accurately.

Figure 1: Artificial intelligence's place in the healthcare industry



Artificial intelligence and computational pathology

Computational pathology based on artificial intelligence is a developing topic that has demonstrated encouraging outcomes in terms of improved accuracy and patient access to top-notch medical institutions across numerous specialties. The main challenges this discipline faces are:

(1) The shortage of qualified pathologists and the restricted resources in the global health care system. [3]

(2) Inpatient care is producing an increasing amount of health data that is available, such as digitalized photographs, clinical examination records, and patient demographic data. [4]

(3) The growing complexity in managing and integrating data from many sources to enhance patient care;

(4) To enhance patient care and comprehend the large amount of data, machine learning-based algorithms must be used. [5]

The enormous volume of data generated throughout the course of a patient's care can be processed by this technology to improve the pathological diagnosis, the disease's classification, and the prognosis. The primary advantage of computational pathology is the reduction of diagnosis and classification errors. Using whole slide imaging (WSI) and hematoxylin and eosin-stained slides, fresh automatic cancer detection algorithms are evaluated as part of the well-known machine-based Cameleon Grand Challenge 2016 (CAMELYON16 challenge). It's produced remarkable results with a sensitivity of 92.4% for tumor identification. In contrast, a pathologist's sensitivity is limited to 3.2%.Six this technician transforms the traditional core function of pathology, including its growing sub-segments such as molecular pathology, digital pathology, and informatic pathology. [7, 8] The approach aims to reduce patient costs, optimize patient care, and raise diagnosis accuracy through global collaboration.

Digital pathology (DP)

The digitalization and virtualization of entire glass slides has been made easier by recent advancements in brightfield and fluorescent slide scanner technology. [9] DP includes the use of computer methods to digitalize histopathology, immunochemistry, and cytology slides. Whole slide scanners are then used to interpret, manage, and analyze the digitalized full slides. The digital data retrieved from the falls can be stored in a central cloud location, which will facilitate its automatic review by a data algorithm and manual analysis by a pathologist. Because of this, artificial intelligence, a branch of computational science, has developed the ability to create algorithms and use them to treat possible diseases. [10] Based on intelligence level, artificial intelligence is now separated into two main categories: inadequate computer and AI technologies. Weak artificial intelligence, also known as narrow AI, is capable of classifying data based on a well-established statistical model and is already skilled at completing those defined tasks. [11] Conversely, strong AI, also known as modern computer technologies, can use machine learning on all accessible average data to build a protocol that can function independently and intelligently.

Machine learning technology

Machine learning (ML), as used in artificial intelligence, is a process that enables a computer system to learn from and advance autonomously through a set of data on its own, solving problems without the need for manual programming. ML is a developing field in artificial general intelligence that makes use of a significant quantity of pre-processing data and training to determine and statistically interpret the algorithms, after which it acts on the data that has been obtained. [12] In pathology, numerous machine learning-dependent methods have now been developed and validated to aid in the diagnosis process based on morphological patterns such as blood vessels, ducts, cancer cells, and cell division. [13]

A subfield of ML known as "structured" or "deep" learning relies on artificial neural networks (ANNs) to create statistical models using input training data. [14] The deep learning architectures are provided by deep neural networks. Because artificial neural networks are capable of evaluating whether a prediction or interpretation is accurate, they mimic the intricate biological neural networks found in the human brain. [15]

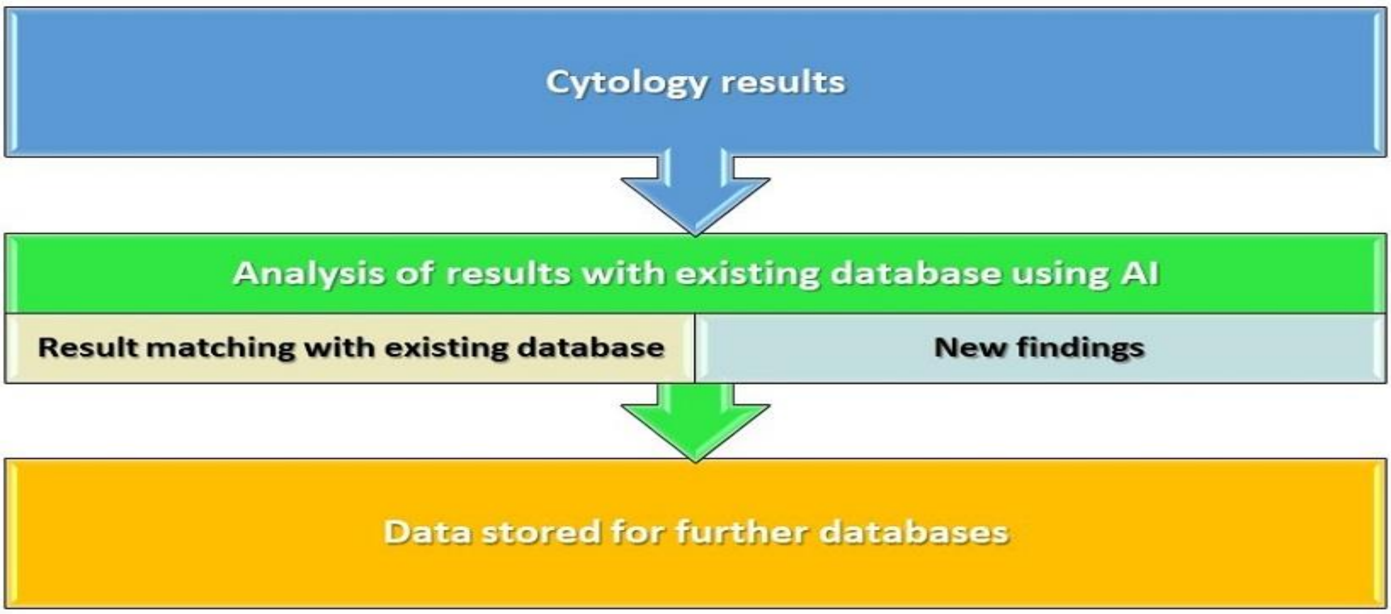
Three levels of artificial neurons, referred to as "nodes," make up artificial neural networks: an input layer, several unseen layers, and an output layer. These artificial neural layers of ANNs are coupled to one another via links known as "weights." Additionally, statistics are used in conjunction with a number of algorithms, K-nearest neighbor, supporting vector machines, and logical regressions to evaluate these linkages. [16] To obtain the best method for a given task, the output event-related artificial neurons, their concurrent connections, and "weight" need to be properly trained and practiced in enormous data set qualifications (Figure 1). Convolutional neural networks specifically made for visual pictures are a subset of advanced multilayer neural networks.

Convolutional kernels perform a pre-procedure treatment by flattening, removing, and reducing the image. This allows modern computer technologies to be used to development, analyze, and categorize digital images, or a portion of an image, into an identified group.

Role of modern computational technologies in pathology

In order to answer clinical questions that come up in practice and in medical research, computational pathology plays a crucial role. [17] In order to attain this purpose, a team of experts from various fields must work on the computational pathology project. This team must include data scientists and bio-informaticians, who design algorithms, as well as architects and engineers who build physical environments and maintain hardware (Figure 2). The pathologists in this project are crucial in posing a query to the development team regarding a medical topic and its clinical ramifications, as well as in starting the downstream industrial development. [18] A pathologist working in computational pathology must have good clinical knowledge and expertise in addition to statistical analysis and data mining skills in order to create a connection between clinical care and artificial intelligence.

Figure 2: Role of AI in Cytology



AI and radiology

Due to the remarkable advancements in image identification tasks namely, the development of sufficient digital data and the availability of significant computational power modern computer technologies has become more widely accepted and popular in the modern medical era, with broad implications for radiology. Medical research has pushed modern computer technologies and its capabilities forward. In addition to rising workload strain on radiologists, there is a shortage of qualified and experienced radiologists and more accessibility to radiographical tests. Modern computer technologies is currently able to automatically diagnose disorders of the liver, heart, lungs, and bones. For instance, a CT scan algorithm for the belly and chest can be used to automatically identify vertebral fractures. Segments and sagittal sections of the spinal column can be seen and the presence of a vertebral fracture can be predicted using a convolutional neural network. [21] Similarly, calcium can be found in the coronary arteries on non-contrast chest CT images using methods that are similar in their capacity to predict cardiovascular events and mortality. [22,23] Additionally, there exists a method that computes bone mineral density, which is equivalent to the dual-energy X-ray absorptiometry score and can therefore identify osteoporosis. [24]

In some domains, such as the identification of cancers detected by mammography and the detection of lymph nodes that have spread, the application of deep learning in diagnostics has demonstrated promising results. [26, 25] In Laukamp et al.'s work, they segmented and recognized meningioma-related MRI images using a multi-parametric deep learning model and compared the results with manual segmentation. The algorithm evaluated 55 out of 56 cases in the same sample of 249 preoperative MRI glioma cases more accurately than two radiologists evaluating the cases by hand using the brain tumour image segmentation benchmark. [27]

AI and oncology

In the diagnosis of breast cancer, artificial intelligence outperforms human readings. ML is a potentially useful technique for cancer diagnosis, according to a study by Somashekhar et al. [28] Watson's concordance rate with a professional multidisciplinary tumour board on treatment recommendations for breast cancer was found to be 93% in a double-blinded validation study. 49 training slide sets with metastatic lymph nodes and 80 sets without were used in the study by Bernard et al. All these slides were compared with 11 diseases, and thus improved the diagnostic efficacy of the algorithms. [29] In addition, it took the pathologists [30] hours to evaluate all 129 slides, whereas the execution time of algorithms was thought to be very small.

Modern computer technologies systems have shown to be more successful in lung cancer identification than human readings in certain circumstances. In a study, Yu et al. used 2186 stained histological whole-slide photos of squamous cell carcinoma and lung adenocarcinoma to show how accurate artificial intelligence can be in pathological diagnosis.thirty the study's conclusion is that by using artificial intelligence to forecast an inpatient's prognosis for lung cancer, oncological therapy decisions can be made with greater accuracy, improving patient care.

Since dermatology relies heavily on visual imaging for the identification and classification of skin lesions, artificial intelligence has demonstrated some encouraging outcomes in this field. In a study by Esteva et al., trained forms of photos were employed alone with illness tags and pixels as inputs and classified in different skin lesions using a single convolutional neural network.

Its efficacy was evaluated by comparing its clinical image data set of 129,450 with that of 21 board-certified expert dermatologists, utilizing clinical images that have been biopsy-proven. Two groups of images were created, one for the most prevalent types of cancer and the other for those with the highest death rates, such as malignant melanomas vs benign nevi and keratinocyte carcinomas versus benign seborrheic keratosis. In all instances during the two challenges, artificial intelligence matched the professionals, proving its superiority over dermatologists with formal trainin. [31]

AI and cardiology

The use of modern computer technologies

and machine learning has sped up interpretation and diagnosis in several areas of cardiology. The interpretation of ECG readings has been automated, as has the measurement of heart functions through echocardiography, the determination of cardiac perfusion using SPECT, and the resolution of coronary artery calcifications by CT angiography.

Automatic segmentation, blood flow monitoring, and perfusion assessment are all possible with cardiac MRI. [32] Modern computer technologies in electronic medical data has successfully decreased mortality by detecting heart failure early. This is due to modern computer technologies ability to complete a longitudinal data assessment in order to find trends and establish heart failure prognosticator. [33] Artificial intelligence (AI) provides a better predictive value by analyzing the patient's electronic medical records when it comes to determining which interventional procedures, such as percutaneous cardiac intervention or coronary artery bypass grafting (CABG), should be performed on patients with angina. This lowers the death rate. [34]

AI and gastroenterology

In gastroenterology, the images obtained from the duodenum, colon, and stomach endoscopy are used to make diagnosis and guide treatment decisions. Early cancer identification is crucial for patient care, and screening programs are put in place all around the world. To enhance the quick and often performed clinical testing procedure, an artificial intelligence (AI) system was created. [35] An automated diagnosis system, such as the CADe system, recognizes anomalous results and indicates the anomalous area on the screen, notifying the endoscopist accordingly. The CADx system can assist in providing a real-time diagnostic with defined endoscopic pictures after identifying an anomaly and switching to a narrowband imaging view. Colon polyps were detected 94% of the time using the CADe system. [36] Additionally, it was demonstrated that the CADx system could differentiate between colon cancer and early-stage gastric cancer using an endoscope. With a specificity and sensitivity of 95% and 96%, respectively, the CADx system showed 96.3% precision in the early detection of gastric cancer. [37]

AI and ophthalmology

It has been demonstrated that modern computer technologies and deep learning are highly beneficial for the early identification of diabetic retinopathy. Gulshan et al. employed two sets of validation data, namely, 9963 and 1748 photographs, and compared with seven board-certified ophthalmologists. They discovered that deep learning had a higher specificity and sensitivity rate. This study suggests that deep understanding in ophthalmology has great promise for detecting macular oedema and diabetic retinopathy from retinal pictures; however, more research is necessary.

AI and surgery

One example of computer sciences that have already entered the operating room but are not yet associated with modern computer technologies is robotic-assisted surgery. The available technology improves an operating surgeon's vision with 3D cameras and near-infrared imaging. It also improves mechanical skills such as tremor elimination, intuitive instrument articulation, and movement scaling, but it hasn't translated into better outcomes for the patient's improved health status. Thus, the expectations for modern computer technologies integrated into operating rooms are high in terms of results. AI can be used in the operating rooms in a number of ways, including supportive anesthesia, monitoring instrumentation during surgery, and workflow improvement to improve time management and patient safety. Emerging technology in surgery called OR.NET allows devices in operating rooms to communicate with one another through a standard interface, improving workflow and patient safety.

AI in covid - 19

During the COVID-19 pandemic, telemedicine and computer-aided medicine made their way onto the markets in numerous nations. Unexpected obstacles to traditional medicine included social isolation, systemic dangers, and a high chance of transmission. Yet artificial intelligence (AI) was a developing medical imaging tool that actively supported the fight against COVID-19. Modern computer technologies has produced imaging solutions that are safer, more accurate, and more efficient than conventional medicine, which heavily depends on human resources. This public health emergency can be managed more safely by applying AI-based computer-aided treatment, clinical data from electronic health records, and individual responses that promptly provide social data. This lowers the clinical risks of spreading through human-to-human interactions. Some of the most current AI-powered COVID-19 applications include a specialized imaging platform for the lungs, segmentation of the infectious region, clinical evaluation, and diagnosis, along with cutting-edge fundamentals and clinical research. In the fight against COVID-19, several commercially accessible solutions that effectively integrated AI were contactless imaging workflows and AI-aided image segmentations, which demonstrate the technology's capabilities.

Cloud-based AI

A novel idea called "cloud-based modern computer technologies allows users to pay for access to constantly updated algorithms. Since this service is available on all devices, this notion also allows for interoperability, which is a benefit. A multitude of cloud-based artificial intelligence platforms have been developed by numerous companies in order to contribute to various medical applications. Cloud-based AI services are provided by organizations like Zebra Medical Vision Ltd., Arterys Inc. (San Francisco, CA, USA), and VIDA, Diagnostics Inc. (Coralville, IA, USA) to support the study of lung disorders, cardiac imaging processing, liver imaging, and bone health [38].

CONCLUSION

The goal of machine learning is to support or enhance medical care, not to take the place of human physicians. While radiologists are becoming more and more in number, the number of radiological scans is not. Help in this area can reduce the amount of time between tests and results because of quicker readings and round-the-clock operation. Furthermore, AI software is not affected by human elements like ambient circumstances or fatigue, which could cause it to slow down or lose accuracy. Modern computer technologies integration into the workflow may be advantageous for pathology due to the growing workload and labor scarcity. It is possible to perform quantitative activities like counting the number of mitoses per high power field and analyzing the morphology. Contrary to common perception, artificial intelligence will not take the place of human physicians in the fields of medicine or surgery. Conversely, AI-enhanced medical technologies will help to improve productivity and deliver more reliable service. The path to modern computer technologies is still convoluted and full of obstacles to overcome, including obtaining FDA approval, moral dilemmas with data sharing, and public attitudes about AI. Modern computer technologies in healthcare should be seen as a tool for decision-making, with humans ultimately making the final call.

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