Review Article

Impact of Artificial Intelligence in Disease prediction and Biomedical Research Rising opportunities in Health care Industry

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ABSTRACT: Artificial intelligence has proved to play an important role in health care industry due to its primary capability behind development of precision medicine widely agreed to be direly needed advancements in care. Even though early efforts of providing diagnosis, management and treatment recommendations have proven challenging, the opportunities are high as AI shall ultimately master that domain as well. AI has proven to be very beneficial for radiological analysis of brain, speech and hearing, biomedical information processing, biomedical research, natural language processing, diagnosis and treatment of blood borne bacterial infections, bladder volume prediction, epileptic seizures, and management of dementia. It is interesting to understand that AI will not replace human clinicians completely, but may augment their efforts to take proper care of patients. In future, health care providers may move towards tasks and human skills that are required like empathy, persuasion and big picture integration, else they may lose their jobs over time, if do not work alongside artificial intelligence.

Key Words: Artificial Intelligence, Prediction, Machine learning, Biomedical research, Clinical design support

INTRODUCTION

Artificial intelligence (AI) is defined as the intelligence of machines, as opposed to the intelligence of humans or other living species [1-2]. AI can also be defined as the study of ‘‘intelligent agents”—that is, any agent or device that can perceive and understand its surroundings and accordingly take appropriate action to maximize its chances of achieving its objectives [3]. AI also refers to situations wherein machines can simulate human minds in learning and analysis, and thus can work in problem solving. This kind of intelligence is also referred to as machine learning (ML) [4]. Typically, AI involves a system that consists of both software and hardware. From a software perspective, AI is particularly concerned with algorithms. An artificial neural network (ANN) is a conceptual framework for executing AI algorithms [5]. It is a mimic of the human brain—an interconnected network of neurons, in which there are weighted communication channels between neurons [6]. One neuron can react to multiple stimuli from neighboring neurons and the whole network can change its state according to different inputs from the environment [7]. The goal for healthcare is to become more personal, predictive, preventative, and participatory, and AI can make major contributions in these directions. From an overview of the progress made, we estimate that AI will continue its momentum to develop and mature as a powerful tool for biomedicine.

AI for living assistance

In the area of assisted living for elderly and disabled people, AI applications using corresponding smart robotic systems are paving the way for improvements in life quality. An overview of smart home functions and tools offered for people with loss of autonomy (PLA), and intelligent solution models based on wireless sensor networks, data mining, and AI was published recently [8]. NNs can be trained with specific image-processing steps to recognize human facial expressions as commands. Furthermore, human–machine interfaces (HMIs) based on facial expression analysis allow people with disabilities to

control wheelchairs and robot assistance vehicles without a joystick or sensors attached to the body [9]. An ‘‘ambient intelligent system” called RUDO can help people who are blind to live together with sighted people and work in specialized fields such as informatics and electronics [10]. People who are blind can make use of multiple functions of this intelligent assistant through a single user interface. A ‘‘smart assistant” based on AI can help pregnant women with dietary and other necessary advice during crucial stages of maternity. It is capable of providing suggestions at ‘‘an advanced level” through its own intelligence, combined with ‘‘cloud-based communication media between all people concerned” [11]. A fall-detection system based on radar Doppler time–frequency signatures and a sparse Bayesian classifier can reduce fall risks and complications for seniors [12]. In fact, ‘‘smart communication architecture” systems for ‘‘ambient assisted living” (AAL) have been developed to allow AI processing information to be gathered from different communication channels or technologies, and thus to determine the occurrences of events in the network environment and the assistance needs of elderly people [13].

AI in biomedical information processing

Breakthroughs have been made in natural language processing for biomedical applications. In the area of biomedical question answering (BioQA), the aim is to find fast and accurate answers to user-formulated questions from a reservoir of documents and datasets. Therefore, natural language-processing techniques can be expected to search for informative answers [14]. To begin with, the biomedical questions must be classified into different categories in order to extract appropriate information from the answer. ML can categorize biomedical questions into four basic types with an accuracy of nearly 90% [15]. Next, an intelligent biomedical document retrieval system can efficiently retrieve sections of the documents that are most likely to contain the answers to the biomedical questions [16]. One novel scheme for processing one of the four basic types of BioQA—the yes-or-no answer generator, which originates from word sentiment analysis—can work effectively toward information extraction from binary answers [17].

AI in biomedical research

In addition to being able to act as an ‘‘eDoctor” for disease diagnosis, management, and prognosis, AI has unexplored usage as a powerful tool in biomedical research [18]. On a global scale, AI can accelerate the screening and indexing of academic literature in biomedical research and innovation activities [19-20]. In this direction, the latest research topics include tumor-suppressor mechanisms [21], protein–protein interaction information extraction [22], the generation of genetic association of the human genome to assist in transferring genome discoveries to healthcare practices [23], and so forth. Furthermore, biomedical researchers can efficiently accomplish the demanding task of summarizing the literature on a given topic of interest with the help of a semantic graph-based AI approach [24]. Moreover, AI can help biomedical researchers to not only search but also rank the literature of interest when the number of research papers is beyond readability. This allows researchers to formulate and test to-the-point scientific hypotheses, which are a very important part of biomedical research. For example, researchers can screen and rank figures of interest in the increasing volume of literature [25] with the help of an AI to formulate and test hypotheses.

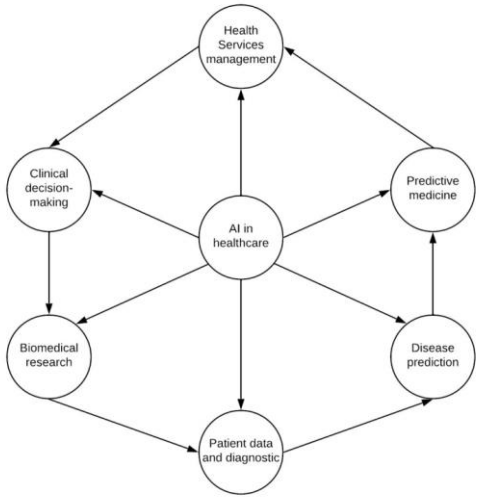
Disease diagnostics and prediction

The most urgent need for AI in biomedicine is in the diagnostics of diseases. A number of interesting breakthroughs have been made in this area. AI allows health professionals to give earlier and more accurate diagnostics for many kinds of diseases [26]. One major class of diagnosis is based on in vitro diagnostics using biosensors or biochips[27]. For example, gene expression, which is a very important diagnostic tool, can be analyzed by ML, in which AI interprets microarray data to classify and detect abnormalities (Fig. 1)

Healthcare

AI is now covering a wide range of healthcare applications [28]. In particular, it has been used for signal and image processing, and for predictions of function changes such as in urinary bladder control [29], epileptic seizures [30], and stroke predictions [31]. Below, we describe two typical case studies: bladder volume prediction and epileptic seizure prediction.

Figure 1: Dominant variables for AI in health care and biomedical research



Bladder volume prediction

When the storage and urination functions of the bladder fail as a result of spinal cord injury or because of other neurological diseases, health status, or aging, various complications occur in the patient's health conditions. Nowadays, partial restoration of bladder function in drug-refractory patients can be achieved using implantable neural stimulators. To improve the efficiency and safety of neuroprostheses through conditional neurostimulation [32], a bladder sensor that detects stored urine is required as a feedback device that applies electrical stimulation only when needed. The sensor can also be used to notify patients with impaired sensations in a timely manner when the bladder needs to be emptied or when an abnormally high residual postmicturition volume remains after an incomplete voiding. We have proposed new methods [33] and developed a dedicated digital signal processor (DSP) [34] for sensing both the pressure and its fullness in urine by using afferent neural activities from the regular neural roots of the bladder (i.e., mechanoreceptors), which depicts the changes during filling.

Epileptic seizure prediction

Epilepsy, a neurodegenerative disease, is one of the most common neurological conditions and is characterized by spontaneous, unpredictable, and recurrent seizures [35-36]. While first lines of treatment consist of long-term medications-based therapy, more than one third of patients are refractory. On the other hand, recourse to epilepsy surgery is still relatively low due to very modest success rates and fear of complications. An interesting research direction is to explore the possibility of predicting seizures, which, if made possible, could result in the development of alternative interventional strategies [27]. Although early seizure-forecasting investigations date back to the 1970s [37], the limited number of seizure events, the paucity of intracranial electroencephalography (iEEG) recordings, and the limited extent of interictal epochs have been major hurdles toward an adequate evaluation of seizure prediction performances.

AI in management of dementia

Machine learning models that can accurately distinguish those with symptomatic Alzheimer's dementia from those with mild cognitive impairment and normal cognition as well as predict progressive disease using relatively inexpensive and accessible ocular imaging inputs are impactful tools for the diagnosis and risk stratification of Alzheimer's dementia continuum [38]. If these machine learning models can be incorporated into clinical care, they may simplify diagnostic efforts. Recent advancements in ocular-based machine learning efforts are promising steps forward [39].

DISCUSSION

Artificial intelligence (AI) generally applies to computational technologies that emulate mechanisms assisted by human intelligence, such as thought, deep learning, adaptation, engagement, and sensory understanding [40-41]. Some devices can execute a role that typically involves human interpretation and decision-making [42-43]. These techniques have an interdisciplinary approach and can be applied to different fields, such as medicine and health. AI has been involved in medicine since as early as the 1950s, when physicians made the first attempts to improve their diagnoses using computer-aided programs [44-45]. Interest and advances in medical AI applications have surged in recent years due to the substantially enhanced computing power of modern computers and the vast amount of digital data available for collection and utilization [46]. AI is gradually changing medical practice. There are several AI applications in medicine that can be used in a variety of medical fields, such as clinical, diagnostic, rehabilitative, surgical, and predictive practices. Another critical area of medicine where AI is making an impact is clinical decision-making and disease diagnosis. AI technologies can ingest, analyse, and report large volumes of data across different modalities to detect disease and guide clinical decisions [42]. AI applications can deal with the vast amount of data produced in medicine and find new information that would otherwise remain hidden in the mass of medical big data [47–49]. These technologies can also identify new drugs for health services management and patient care treatments. The technology will potentially reduce care costs and repetitive operations by focusing the medical

profession on critical thinking and clinical creativity. The AI perspective is exciting; however, new studies will be needed to establish the efcacy and applications of AI in the medical field [50].

Conclusions

It is very evident that on AI strategies for healthcare from the accounting, business, and management perspectives. Structured literature review (SLR) method was employed for its reliable and replicable research protocol [51] and selected bibliometric variables as sources of investigation. Bibliometric usage enables the recognition of the main quantitative variables of the study stream [52]. This method facilitates the detection of the required details of a particular research subject, including field authors, number of publications, keywords for interaction between variables (policies, properties and governance) and country data [53]. It also allows the application of the science mapping technique. The investigation offers potentials insights for future researchers and practitioners.

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