Artificial Intelligence Integrating with Human Medicine

Abstract

Artificial intelligence is a subcategory of computer science, and it has been growing since it was first discovered more than sixty years ago [10]. There are many different categories of artificial intelligence, and they are beneficial to different career fields including human medicine. Machine learning is one category of artificial intelligence that is being thoroughly researched constantly. The use of artificial intelligence in human medicine has already started to benefit the patients and the physicians in areas such as cardiology, orthopedics, neurology, and others by increasing patient care. When thinking about how artificial intelligence will continue to impact the human medicine field, one must weigh the pros and cons of implementing the use of artificial intelligence.

Introduction

Artificial intelligence (AI) is a growing field within the computer science profession, and it is used within many career fields including robotics, philosophy, linguistics, and many others [5]. Artificial intelligence, which is a huge topic of smaller groups, is a subcategory of computer science in which it strives to mimic human thought processes and learning capacity [1], and it has been able to surpass human test subjects [7] with the recent advances in AI. The use of artificial intelligence is also growing within the medical community and is being applied to improving patients' care as well as assisting in various types of surgeries. Artificial intelligence computer models can be applied within various fields of medicine, but physicians must understand the foundation, how it might impact the health field, and how to interact with the technology [5].

Machine Learning

Machine learning, which is a subset of AI, can be separated into three categories of learning types such as supervised, unsupervised, and reinforcement. Both supervised and unsupervised learning is relevant in the field of modern medicine. Using big data, the objective of unsupervised learning is to identify certain disease mechanisms, genotypes, and phenotypes without feedback from humans. Reinforcement is a combination of supervised and unsupervised and is used to increase the accuracy of algorithms by trial and error. Machine learning and c-statistics can be used in similar ways but require different factors when it ultimately comes down to what they are used for. In order to use machine learning to help diagnose certain diseases, it uses a lot of training datasets, and one has to consider overfitting or underfitting. Overfitting is noisy data while underfitting is suboptimal data. Machines learning certain diseases should begin learning a few keywords related to that disease. If the disease is more commonly associated with women, then it might not consider men, which is considered underfitting. If a machine only associates the keywords given with one disease and not other diseases that those keywords are associated with, then that is considered overfitting [1]. In regards to digital image interpretation, overfitting tends to identify the image with an intended outcome instead of the pattern that makes up the outcome [7]. Shah et al used an unsupervised learning model to identify structures within patients diagnosed with high frequency ejection fraction but learned that the cluster pattern needs to be programmed without bias [3]. Machine learning is very useful when one wants subtle patterns identified in large datasets [5].

Medical students that are taught before they start to see patients is an example of supervised learning. Certain algorithms are good candidates for supervised learning such as k-nearest neighbor, naive Bayes classifier, decision trees, and more. These algorithms have already been successfully implemented in understanding cardiovascular disease better and interpreting cardiovascular imaging. Artificial neural networks, which are inspired by biological nervous systems [5], and support vector machines are the more popular algorithms because they can process large data much easier and with higher accuracy than other algorithms [1]. Artificial neural networks are similar to graphs in which they contain weights that change as the network learns different input-output maps that correspond to different tasks such as pattern recognition or data classification [5]. They also mimic the human neuron concept, and they have a wide variety of uses including integration with deep learning algorithms, but they do have their limitations such as a long computation time [1]. However, they have outperformed more traditional approaches when it comes to risk prediction [5]. Support vector machines require less memory and have been useful in recognizing patterns within echocardiograms as well as helping physicians make decisions. Supervised learning does have limitations such as inaccurate decisions when it is dealing with small datasets when the training datasets are biased. Supervised learning is only able to predict known results [1].

Medical residents that see patients and learn from their mistakes in order to improve their triage protocol is an example of unsupervised learning. Unsupervised learning has the ability to use unlabeled data sets to predict unknown results and discover hidden patterns in datasets used. Algorithms that fall under unsupervised learning are categorized into cluster and association rule-learning algorithms. Cluster algorithms are used for clustering unlabeled data into different groups while association rule-learning algorithms help to uncover relationships to “seemingly unrelated data items”. Unsupervised learning also has its limitations in which they are known to have trouble identifying the initial cluster pattern, which can lead to biases and inaccurate decisions [1]. Machine learning and its subsets are a very powerful tool when used.

Deep Learning

Deep learning algorithms, a subset of machine learning, are modern networks ranging from 8 to 1,00 layers, and they have outperformed older and shallower models in every category [7]. Deep learning emulates the human thinking process but uses multiple layers of artificial neural networks, which can generate automated predictions depending on the input. Deep learning has very few limitations because it can be trained for unsupervised learning tasks, such as interpreting digital images. Because of deep learning’s vast uses, it can provide patients with higher quality of care while reducing costs. Convolutional and recurrent neural networks are deep learning algorithms that excel at recognizing speech and images [1]. Although deep learning algorithms have many uses, they do require the large training datasets to be accurate and the decision process of the system is not very well understood because it is built on the black box model [12].

Cardiology

Cardiovascular diseases are caused by multiple factors including behavioral, environmental, and genetics. Big data that is used by deep learning AI can be used for image recognition for cardiovascular imaging, which is a non-invasive method of gathering images of the heart by ultrasound or magnetic resonance imaging (MRI). AI can be used to identify new phenotypes or genotypes of heart failure by measuring heart ejection fraction [1]. Heart ejection fraction is the amount of blood ejected by the ventricle relative to its end-diastolic volume [2]. 2-dimensional speckle tracking is a method of assessing left ventricular ejection fraction but is not the most efficient because the latter is measured manually or by the “eyeball” method, which both lack reproducibility and precision [1]. Additionally, AI might be a suitable candidate for improving 2-dimensional speckle tracking quantitation. c-statistics are a simple scoring system that is currently used to predict congenital cardiovascular diseases between different demographics. AI application accessing big data such as electronic health records will likely reduce the need for the c-statistic scoring system. Choi et al was able to use recurrent neural networks to predict heart failure nine months before it was diagnosed and discovered that they are superior to supervised machine learning algorithms [8]. Kannathal et al classified electrocardiograms into three different classifications using deep neural networks and found that it was approximately 99% accurate in multiple test cases [9].

Orthopedics

As of 2017, although deep learning has become more popular in mainstream media, it has not been applied to interpreting orthopedic radiographs. Based on Olczak’s study in 2017, the artificial intelligence network interpreting orthopedic radiographs performed on par with the humans, but 5 times out of 6, the network was correct while there was human error [7]. Deep learning AI has shown improved accuracy interpreting digital-imaging data and disease detection when compared to conventional imaging. Orthopedic conditions diagnosed using deep learning AI include different types of fractures, distinguishing between malignant or benign bone tumors, determining prognosis for cancer patients, as well as mapping disease progression for hip dysplasia and other degenerative joint diseases [4]. Even though the image quality might be limited, the deep learning networks could adequately identify key image properties [7]. Because of these studies, surgical orthopedic procedures have the opportunity to become more efficient when combined with AI [4].

Neurology

AI has shown to help improve diagnostics in cerebral palsy patients according to Bernard [10]. AI can diagnose neurological disorders within seconds, and this has been proved useful in diagnosing stroke victims, which require a fast diagnosis in order to minimize progressive neurological degeneration. Convolutional neural networks can correctly detect neurological findings such as stroke, haemorrhage, or hydrocephalus approximately 79% faster than humans but with a lower specificity. The benefits of this helps physicians develop a better triage protocol to treat people faster who might need treatment faster [11]. Neuro-ophthalmic conditions are very rare, affecting only 3.5% of the population age 40-80, but the use of deep learning neural networks has been able to detect the disease on digital images. Using deep learning neural networks have proven difficult because it requires large training datasets but has been accomplished using optic disc appearance alone or in combination with optical coherence tomography. Although ophthalmologists can easily detect optic disc abnormalities, non-ophthalmic healthcare professionals lack that skill, which can be very useful in emergency situations in which the patient might have a life-threatening disease such as primary intracranial hypertension or secondary intracranial hypertension, which is caused by other underlying conditions[12].

Looking Towards the Future

Ethical, legal, policy, and practice considerations are being considered when moving forward with introducing the use of AI more into human medicine. Especially with the integration of AI, physicians must disclose exactly what the planned outcome is for the procedure. Due to AI companies withholding datasets as proprietary information, the possibility of lack of understanding the data could potentially lead to legal issues including medical malpractice. If an artificial intelligence algorithm can diagnose orthopedic conditions more efficiently than a board-certified musculoskeletal radiologist, then there is a possibility of school funding diminishing. A redesign of current medical programs might happen because of this, although the need for technology might need to be more implemented in medical programs than ever before. There will have to be distinct roles set in place for machines and physicians. One of the purposes of using AI in the medical field is to reduce cost by decreasing resource utilization. This should be considered when initially investing in artificial intelligence machinery [4]. Since the type of patterns AI recognizes is affected by biases in data collection, women and racial minorities can be seriously impacted due to underrepresentation in clinical trials [5]. Autonomous robots that can recognize organs, tissues, and surgical targets would ideally be built from deep learning models using artificial neural networks. Deep learning machine models can learn much faster on their own than the human brain can , but it requires large amounts of high quality annotated data to build. The advancement of using artificial intelligence in human medicine ultimately relies on the assurance of security of data, because an algorithm that is hacked has the opportunity to harm people [6].

Conclusion

Integrating AI with human medicine is important because it can help improve patient care and costs. Artificial intelligence can be integrated into many fields including human medicine. The understanding of AI has grown dramatically throughout the years, but it is continuing to be researched and should continue to be researched. The various implementations of AI might prove to be somewhat limitless based on the massive amounts of information that can be found. AI is particularly useful at interpreting images among medical fields. The research will show not only how useful and powerful it can be but also that it can be used for other unknown uses. In order to propel the research field regarding AI, there will need to be more interest, time, and money invested into it.

Citations

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