The application of artificial intelligence in radiology

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Abstract: Artificial intelligence (AI) is becoming more and more important in various areas of our lives. One of the areas that can greatly benefit from the use of AI is healthcare. The aim of this paper is to research into the application of AI in healthcare, particularly, the application of AI in such an area of healthcare as radiology. The paper describes how AI is currently being used in radiology and explores some of the most notable use cases of this technology. Furthermore, the paper discusses some of the main challenges that AI has to deal with when it is deployed in healthcare. For example, such problems as the availability of data and legal responsibility are discussed. Then, the paper delves into how this technology might improve healthcare in general and radiology in particular as well as some concerns regarding its development. Finally, the paper discusses some of the ways of how this technology might develop in the future.

1. Introduction

It is believed that the advancements in AI and computerisation are going to have a significant effect on the workplace. It is said that most of the things that are currently being performed by human workers could be automated in the near future.

When it comes to industries where AI can be most efficiently applied, medicine is of particular interest, and the topic of the usage of AI in this field has been one of the most researched topics in recent years. There have already been some studies indicating that certain healthcare activities can be carried out by AI better than doctors can. For example, right now when it comes to detecting malignant tumours, AI has proved to be more effective than human radiologists. However, this does not mean that AI is going to replace humans in terms of broad medical process domains.

Artificial intelligence in healthcare can be divided into types: physical and virtual. The virtual type includes such uses as digital health systems, which are used to record patient data, and neural networks, which are used as a guidance in making decisions regarding treatment. The physical type is about using robots which can help surgeons perform surgeries as well as smart prostheses for the handicapped.

The point of medicine, which is based on evidence, is establishing medical understandings and connections by means of patterns and relations from the existing data. Traditionally, statistical methods were used for making these patterns and relations. Flowcharts and databases are the technique that computers use for learning how to diagnose a patient.

1.1. AI in Radiology

AI has been one of the most researched and talked about technologies for radiology in the last couple of years. There is an increasing number of vendors claiming to have developed AI products which are going to reduce the workload of radiology specialists who are hardly able to keep up with large quantities of data they are frequently presented with.
However, it is too soon to speak about widespread incorporation of AI into radiology. In spite of the fact that it is a promising technology and has great potential, it is still in its infancy and a lot needs to be done for its widespread adoption to take place.

2. Use cases
There have been documented some use cases of radiology combined with AI and some of the most notable ones will be discussed below.

2.1. Computer-aided detection
A system that is widely used by doctors for interpreting medical images known as computer-aided detection (CAD) is considered to be one of the first examples of artificial intelligence in Radiology. This system has been applied in radiology in the last twenty years for detecting different types of cancer. However, the beginning of this research dates back to 1973, and this system has found uses in various applications which are currently being exploited by radiology specialists. The main purpose of these applications is detecting lung, breast and colon cancers.

However, it is important to point out that CAD is not viewed as “real” AI by many researchers in this field because CAD can only diagnose a disease if someone has taught it specifically for that task and its recognition abilities can only be enhanced if the CAD algorithm receives some new datasets. Whereas, real AI is about learning things autonomously without anyone having to explicitly program it to perform these tasks. To qualify as real AI, this system should be able to learn on its own based on a network consisting of algorithms and connections. That is, it should be able to do what humans do.

At present, there is a big body of research available in regards to the usage of AI for recognising images in an attempt to detect various types of diseases and classify these images, and assess how treatment affects patients. Nevertheless, it is not an easy task to differentiate between papers on the usage of CAD and those which are related to the pure use of machine learning because both of these areas have something to do with artificial intelligence.

2.2. Magnetic resonance image
It is very difficult to get an image of the beating by means of medical imaging and accomplishing this task takes a lot of time. The process requires experts to spend hours interpreting terabytes of data. This is also hard on patients because it causes discomfort during the process of scanning their body and then waiting for the results for far too long.

Arterys, a digital health company, in conjunction with Stanford University and the University of California, have developed software based on cloud technology to examine seven dimensions of data on heart blood flow at the same time. This deep learning application allows radiologists to perform the analysis in about an hour or less.

3. The main barriers
When a new technology is introduced, it has a lot of obstacles which need to be overcome in order for it to succeed. As any other technology, AI in radiology has many obstacles, which prevent it from reaching its full potential. Some of the main barriers hampering the development of this technology will be discussed below.

3.1. Rare findings and training
In order for AI to train effectively, it needs large amounts of data consisting of medical images but this data needs to be curated and filtered for AI to interpret it correctly. However, this process requires a lot of time and effort. It is important to handle rare findings effectively because they are a possible weak point. It is very difficult to train the algorithm when it comes to rare findings because there are not enough examples for the algorithm to make decisions with confidence.

3.2. Regulation and ethical issues
At the moment, we have to trust software developers to behave in an ethical way so that AI applications function according to certain ethical standards. An AI invention, which is used in healthcare, has to be
regulated as any other healthcare equipment. In order to guarantee the protection of patients, strict criteria of responsibility and helpfulness, which are applied to new drugs and medical devices, must also be applied to AI technologies.

There is not enough research conducted in regards to the usage of AI in various aspects of healthcare. There is still much work to be done to better evaluate the advantages and potential disadvantages of AI in radiology. The ethics of the healthcare community and technical factors will play a major role in shaping this technology. The main objective of radiology has to be to deliver as much value as possible by means of AI but it has to be done in an ethical way. The top priority of the practitioners has to be the ethical use of AI and avoiding any unethical practices for the sake of extra monetary gains.

People involved in developing this technology have to be fully aware of these issues. They have an obligation to know the risks involved and keep patients and stakeholders informed about any pitfalls of AI products and protect them from them. Not only should this product be beneficial as such, but also its benefits should be distributed equally among people. Of course, the changes brought about by AI will be beneficial but this will also have some social and economic consequences and those consequences usually have a negative impact on the most vulnerable communities. Thus, it is of paramount importance to make sure that this situation is not exacerbated by unethically distributing the benefits of AI.

Radiology based on AI is an advanced system of healthcare which is grounded on mathematical and technological advances as well as business and economics, and it is not that easy to determine what moral behaviour is in this scenario. The subject of technological advancements being potentially harmful is constantly being discussed by popular media. The use of AI in different areas of medicine should be guided by conscientious ethical values and the community should be alerted to any unethical AI practices.

3.3. Legal responsibility
When it comes to the use of AI in healthcare, the question of who should be held accountable for the wrong diagnosis is very important. If a diagnosis is made by AI, should doctors be responsible for errors or the manufacturers and data scientists who were involved in the development of this technology.

3.4. Availability of data
One of the major limiting factors of this technology is that large amounts of data are required for an AI algorithm to train effectively. Developers have various approaches to obtain the necessary data. For example, some of them contact patients directly while others work with academic databases or institutions. The important point is that the data of patients may only be used if they agree to it. Not only that, it is necessary to ask patients to give their consent again if their data is used in some other context.

3.5. Radiomics
In medicine, a technique used for extracting large quantities of features from medical images by means of algorithms, which characterize data, is known as radiomics. These features, also referred to as radiomic features, are able to see the characteristics of a disease which the naked eye cannot see. Radiomics provides valuable data for personalized therapy by means of unique imaging features for making a prognosis on different types of health conditions. Radiomics originates from oncology and it is mainly applied in that area of medicine but it can be used in any medical field where it is possible to image a disease. Thus, radiomics is an important part of AI in radiology which provides the ability to get data from large volumes of research which is not limited by location, and exploit this data for predicting the result or reaction to treatment. The examination of huge datasets by a neural network can separate significant connections that might not ever be observed by just visually interpreting studies, which may become crucial for personalized healthcare in the future. However, these connections may not always be relevant or meaningful because they are the results of algorithms. Thus, it is important to keep in mind that some of the results produced by data mining might not make any sense.

3.6. Algorithms created for specific uses
A big number of algorithms for radiology are there to do one thing, for example, Alzheimer’s disease prediction, bone age estimation, lesion assessment etc. Of course, these applications are good for
performing that one task but it may not be cost-effective to buy a product which has only one use. According to some experts, if there is a separate algorithm for each task, it is going to be too much work.

3.7. Algorithms not suitable for the existing workflow
When there is a big number of algorithms out there but too little training data for algorithms to expand their use, radiologists have to deal with algorithms that are not suitable for their workflow.

4. Discussion
It is not an exaggeration to say that AI is becoming an important part of healthcare and is going to influence most of the areas of medicine, particularly radiology. Doctors as well as patients will benefit from AI-based computer applications.

It is difficult to develop medical products to fight a disease because this process involves clinical trials that could go on for years and the cost is very high. There has recently been an example where AI was applied to drugs that already exist, which could be used to fight the Ebola virus and were it not for AI, years would have been spent to process them.

According to some studies, AI was able to better classify skin lesions. This is because it is able to go through multiple cases over a span of several minutes, which is far greater than what a human doctor could do in their lifetime. Of course, this area of AI based medicine has lots of sceptics as well as advocates. The increasing usage of modern technology has led to fewer job prospects, and many people who are studying to become doctors and people who are already working as doctors view as something negative. AI systems may be able to replicate some human behaviours but when it comes to such human qualities as communicating well, thinking critically, being creative and emotionally intelligent, AI is not capable of competing with humans.

There is no doubt that AI is going to be one of the most important parts of healthcare. Therefore, it is crucial to teach future doctors to work alongside machines so that everyone involved might greatly benefit from its use.

5. Conclusion
The development of AI promises to transform healthcare in ways that have never been known before. With its help large amounts of data can be quickly analysed which results in providing better treatment for patients, which is better tailored to their condition. It would take years of trials to achieve this. A paradigm shift might take place in the near future which will transform the way healthcare works in many ways, and patients will receive care that is more personalised.

It is important for radiologists to familiarize themselves with AI based applications so that they do not lag behind in this new era of healthcare which we are moving towards. The main aim should be a balance between AI and doctors who should work on their human qualities which cannot be offered by AI. This is important because the fear of humans being replaced by AI is something that stands in the way of developing this technology and taking advantage of its benefits.

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