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Abstract

Cancer is an aggressive disease with a low median survival rate. Ironically, the treatment process is long and very costly due to its high recurrence and mortality rates. Accurate early diagnosis and prognosis prediction of cancer are essential to enhance the patient's survival rate. Developments in statistics and computer engineering over the years have encouraged many scientists to apply computational methods such as multivariate statistical analysis to analyze the prognosis of the disease, and the accuracy of such analyses is significantly higher than that of empirical predictions. Furthermore, as artificial intelligence (AI), especially machine learning and deep learning, has found popular applications in clinical cancer research in recent years, cancer prediction performance has reached new heights. <https://pubmed.ncbi.nlm.nih.gov/31830558/>. In this project we are giving an introduction regarding cancer and how it can be diagnosed and treated. We are looking at how AI can be used in cancer diagnosis and treatment and we are also looking at how different ML algorithms can be used for predicting Cancer. We are also using the dataset for Breast Cancer and training a logistic regression algorithm based on the data set for prediction.

INTRODUCTION

Cancer refers to any one of a large number of diseases characterized by the development of abnormal cells that divide uncontrollably and have the ability to infiltrate and destroy normal body tissue. Cancer often has the ability to spread throughout your body. Cancer is the second-leading cause of death in the world. But survival rates are improving for many types of cancer, thanks to improvements in cancer screening, treatment and prevention.

Artificial intelligence (AI) and machine learning (ML) are gradually strengthening their impact in everyday life and are believed to have a dominant influence in digital health care for disease diagnosis and treatment in near future. Technological advancements in AI and ML have paved the path towards autonomous disease diagnosis tools by utilizing big data sets to meet the future challenges for human disease detection at a very early stage specially in cancer. ML is the subset of AI, where neural network base algorithms are developed to allow the machine to learn and resolve problems like the human brain AI is growing by leaps and bounds. Research on clinical oncology is now more focused to decode the molecular onset of cancer by understanding the complex biological architecture of cancer cell proliferation. It also focused to process the millions of relevant cases in big data and computational biology to tackle the current scenario of expanding number of cancer mortalities in the globe. With the rise of AI technology, attempts to make machines that can sense biological changes like human intelligence have been done by getting real-time and comparative data from the population pool for precise clinical interpretation. (https://cancerci.biomedcentral.com/articles/10.1186/s12935-021-01981-1#Sec1)

Artificial intelligence (AI) is concretely reshaping our lives and it is time to understand its evolution and achievements to model future development strategies. This is true also for oncology and related fields, where AI is now opening new important opportunities for improving the management of cancer patients. (<https://www.nature.com/articles/s41416-021-01633-1>)

PROBLEM

Many countries such as India face challenges in terms of limited healthcare resources available to treat the swelling number of cancer cases. The ratio of patients seeking care for cancer to the availability of cancer specialists is very high compared with developed countries. Indian oncologists, on average, treat a much larger number of cancer patients than their Western counterparts. The pathologist-patient ratio is also highly skewed, and hence the cancer care infrastructure in India faces enormous time pressure, with doctors having to examine a staggering amount of information to make treatment decisions, for every single cancer patient. The result is overcrowded health care facilities and long waiting periods in hospitals equipped to deal with cancer.

This is where artificial intelligence (AI) can be a game changer. One of AI‘s key strengths is that it is able to process vast and complicated data in short amounts of time, and help automate routine tasks to reduce the level of human intervention needed.

AI IN CANCER DETECTION

Early detection of cancer is the key to saving the lives of patients.

The use of AI in cancer detection has been expanding over the years. Not only Ai can be used in detection of cancer but also it is used for increasing the accuracy of detection. Research has developed many machine learning algorithm which detects cancer by analysing tissue scans and as well or better than pathologists. One such model was developed in the United states which can recognize the images of colorectal cancer which is one of the most common causes of cancer-related deaths across Europe and US. The research gathered over 13,000 images of colorectal cancer and using these images a machine learning algorithm was developed. This algorithm scored an accuracy of 98% whereas the accuracy of detection of colorectal cancer by pathologists was 96% .

AI can also advance existing technologies to improve patient outcomes. With the help of machine learning algorithms, we can accurately predict whether a person will or will not have cancer by just analysing the characteristics of the tumour .

BREAST CANCER PREDICTION USING ML

With the data set for breast cancer provided by uci machine learning, we have developed a prediction model using logistic regression algorithm.

In this model firstly we are applying data analysis techniques in which various characteristics of tumour are analysed. Machine learning algorithms uses linear algebra and probability to find relationship between the various properties of tumour developed and the diagnosis which tells whether the person has benign or malignant tumour .

The data set contains the following characteristics of tumour:

id (patientid)

name

radius (the distance from the center to the circumference of the tumor)

texture (standard deviation of gray-scale values)

perimeter (circumference of the tumor, approx. 2\*3.14 \*radius)

area

smoothness (local variation in radius lengths)

compactness

concavity (severity of concave portions of the contour)

symmetry

fractal\_dimension

age

diagnosis: 0 or 1 indicating whether patient has breast cancer or not

firstly we are breaking the data set into two parts one for training the logistic regression model and the other part for testing the data set and predicting the accuracy of the model.

The predictions that we made gave an accuracy of 94.6% on the training model and an accuracy of 94.4% for the testing model.

Github link(reference https://github.com/pratikkaushik14/Breast-Cancer-Prediction-using-Logistic-Regression/blob/master/Breast\_Cancer\_Prediction%20using%20Logistic%20Regression.ipynb)

Furthermore the accuracy of these predictions can be increased by the usage of advanced AI algorithms like Neural networks etc which will increase the accuracy of detection.

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According to researchers, by combining mammography capabilities and AI, the technology can significantly reduce the workload for radiologists, and improve patient outcomes.  (<https://healthitanalytics.com/features/top-opportunities-for-artificial-intelligence-to-improve-cancer-care#:~:text=According%20to%20the%20National%20Cancer,lead%20to%20better%20health%20outcomes>.)

AI IN CANCER TREATEMENT

Personalized cancer medicine

By applying AI and machine learning to multiple data sources, researchers are taking first steps toward developing personalized treatments for diseases from cancer to depression. Here, AI is in action today and making great strides in cancer treatment by leveraging patient medical history and tumour characteristics to help generate multiple treatment options.

Cancer is a disease caused by mutations or damage to genes. If the gene, is damaged our body is damaged.

The term personalized medicine means that for an individual the medical care is based on that individual’s genes and that individual’s specific disease. Many cancer affects or involve specific genes Personalised cancer care arises from the studies of human genes and genes in different cancers. Researchers have also used genetic information to develop treatments for cancer and ways to prevent it.Since personalized healthcare is more specific to an individual, it will have lesser side effects than other types of treatements.

Before personalized medicine, people with the same type of cancer usually got the same treatment. Over time, doctors noticed the treatments worked better for some people than others.Then, researchers began finding genetic differences in people and their cancers. These differences explained a great deal about why cancers responded differently to the same treatment. (https://www.entrepreneur.com/article/362227)

With the help of AI and machine learning algorithms we can generate personalized treatments such as personalized radiation therapy. Traditional radiation therapy is delivered to patients uniformly. Dosing Guidelines do not take information about a patient’s individual risk factors or tumour characteristics into consideration on treatment. The main aim of personalized radiation therapy is that with the help of a patients medical imaging data and clinical risk factors machine learning and AI can generate a unique radiation for each patient .This will further minimize side effects and reduce treatment failures by a large margin.

AI in cancer drug development

Another Way in which AI can help in the treatement of cancer is in the field of cancer resistant drugs. The application of AI and machine learning can be applied in various stages of drug development including the chemical structure of drugs, target validation and investigating drug trials and managing clinical trials. Many deep learning algorithms are being used to sift through millions of molecules in a single day which normally takes upto 2 months.

Different cancers and the same drugs may have different reaction modes and data from high-throughput screening procedures often reveal the relationship between genomic variability of cancer cells and drugs. AI can quickly understand how cancer cells become resistant to cancer drugs by learning and analyzing data on large drug-resistant cancer, which can help improve drug development and adjust drug use activity(<https://www.sciencedirect.com/science/article/pii/S0753332220304479#:~:text=AI%20can%20manage%20the%20use,to%20optimize%20the%20chemotherapy%20regimen.&text=AI%20can%20help%20doctors%20make,improve%20patients'%20cancer%20treatment%20plans>.)

AI in immunotherapy

AI application in immunotherapy mainly focuses on evaluating the effects of different treatments and helping doctors adjust their prescriptions. A research team at UT Southwestern Medical Center and MD Anderson Cancer Center built an AI-powered technique for identifying which neoantigens (peptides produced by mutations in cancer cells’ genomes) are recognized by a patient’s immune system. Such AI algorithms would allow predicting cancer cells' response to immunotherapies. Our immune system’s T cells are constantly watching for signs of cancer and other invading bodies. When these cells recognize neoantigens, they bind together. However, some neoantigens remain unrecognized, allowing cancer to grow. There are tens of thousands of types of neoantigens. Analyzing their ability to trigger T cells’ response is a tedious, costly, and time-consuming task. With the help of machine learning, this is becoming possible. Here is what Tao Wang, PhD, Assistant Professor, Population and Data Sciences at UT Southwestern Medical Center, [said about this matter](https://www.news-medical.net/news/20210924/AI-technique-could-lead-to-new-ways-to-predict-cancer-prognosis-and-treatment-response.aspx), “Determining which neoantigens bind to T cell receptors and which don't has seemed like an impossible feat. But with machine learning, we're making progress." Having this knowledge would allow researchers to develop personalized T cell-based therapies and cancer vaccines, and it will help predict patients’ response to immunotherapies.( https://itrexgroup.com/blog/ai-in-cancer-detection-treatment-applications-benefits-challenges/#)

CONCLUSION

AI should be seen as something that helps cancer specialists spend less time on routine tasks, reduce variabilities and minimize human errors. AI can sift through large data sets and also aid in decision making rather than be a standalone tool for diagnosing patients in a completely unsupervised environment. Oncology can be a great example in which humans and technology can work together thereby producing magnifigent results and also providing the best treatement for cancers.