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Artificial Intelligence in Healthcare

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Abstract: .Artificial intelligence (AI) aims to mimic human cognitive functions such as "learning" and "problem solving and nowadays great changes are brought in healthcare. This increases healthcare data and rapid progress of analytic techniques. This further led to the recent successful applications of AI in healthcare. Popular AI techniques include machine learning methods for structured data, such as the classical support vector machine and neural network, and the modern deep learning, as well as natural language processing for unstructured data. Major disease areas that use AI tools include cancer, neurology and cardiology. Human physicians will not be replaced by machines, but AI can definitely assist physicians to make better clinical decisions or even replace human judgment in certain functional areas of healthcare.

Keywords: Artificial Intelligence, human cognition, machine learning, Natural language processing

I. INTRODUCTION

Artificial Intelligence (AI), also called machine intelligence, is intelligence demonstrated by machines, in contrast to the natural intelligence displayed by humans and other animals. Kaplan and Haenlein define AI as "a system's ability to correctly interpret external data, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation. They classify AI into three types: analytical, human-inspired, and humanized artificial intelligence. Analytical AI has only characteristics consistent with cognitive intelligence; generating a cognitive representation of the world and using learning based on past experience to inform future decisions. Human-inspired AI has elements from cognitive and emotional intelligence; understanding human emotions, in addition to cognitive elements, and considering them in their decision making. Humanized AI shows characteristics of all types of competencies (i.e., cognitive, emotional, and social intelligence), is able to be self-conscious and is self-aware in interactions with others. The goals of AI research include reasoning, knowledge representation, planning, learning, natural language processing, perception and the ability to move and manipulate objects.

II. APPLICATIONS OF ARTIFICIAL INTELLIGENCE

Advancements in AI include autonomous vehicles (such as drones and self-driving cars), medical diagnosis, creating art (such as poetry), proving mathematical theorems, playing games (such as Chess or Go), search engines (such as Google search), online assistants (such as Siri), image recognition in photographs, spam filtering, predicting flight delays, prediction of judicial decisions and targeting online advertisements. Banks use artificial intelligence systems today to organize operations, maintain book-keeping, invest in stocks, and manage properties. Military drones are very useful and are capable of autonomous action.

III. ARTIFICIAL INTELLIGENCE IN HEALTHCARE

Artificial intelligence (AI) in healthcare is the use of algorithms and software to approximate human cognition in the analysis of complex medical data and to make conclusions without direct human input.AI technology in health care gain information, process it and give a well-defined output to the end-user through machine learning algorithms, which can recognize patterns in behavior and create its own logic. To reduce error, AI algorithms need to be tested repeatedly. The primary aim of health-related AI applications is to analyze relationships between prevention or treatment techniques and patient outcomes. Medical institutions like The Mayo Clinic, Memorial Sloan Kettering Cancer Center, Massachusetts General Hospital, and National Health Service, have developed AI algorithms for their departments. Additionally, hospitals are looking to AI solutions to support operational initiatives that increase cost saving, improve patient satisfaction, and satisfy their staffing and workforce needs. Companies like Hospital IQ are developing predictive analytics solutions that help healthcare leaders improve business operations through increasing utilization, decreasing patient boarding, reducing length of stay and optimizing staffing levels.

1. Managing Medical Records and Other Data

The first step in health care is compiling and analyzing information like medical records and past history. So data management is the most widely used application of artificial intelligence and digital automation. Robots collect, store, re-format, and trace data to provide faster, more consistent access.

2. Doing Repetitive Jobs

Analyzing tests, X-Rays, CT scans, data entry, and other tasks can all be done faster and more accurately by robots. Cardiology and radiology are two disciplines where the amount of data is large.

3. Treatment Design

AI systems have been created to analyze data notes and reports from a patient's file, external research, and clinical expertise to help select the correct, individually customized treatment path.

4. Virtual Nurses

AI has developed Molly, a digital nurse to help people monitor patient's condition and follow up with treatments, between doctor visits. The program uses machine learning to support patients, specializing in chronic illnesses and to answer patient's questions and help reduce unnecessary hospital visits

5. Medication Management

The National Institutes of Health have created the AiCure app to monitor the use of medication by a patient. A smartphone's webcam combined with AI, can confirm that patients are taking their prescriptions and help them manage their condition. People with serious medical conditions, patients who tend to go against doctor advice, and participants in clinical trials benefit from this.

6. Drug Creation

Drug research and discovery is the more recent applications for AI in healthcare. The path from research lab to patient is a long and costly and it takes an average of 12 years to travel from the research lab to the patient. Only 5 in 5,000 of the drugs that begin preclinical testing ever make it to human testing and just 1of these 5 is approved for human usage. Using AI to streamline the drug discovery and drug repurposing processes, significant changes can be done to save cost and time. A program powered by AI was used to scan existing medicines that could be redesigned to fight the Ebola virus disease.

7. Precision Medicine

Genetics and genomics look for mutations and links to disease from the information in DNA. With the help of AI, body scans can spot cancer and vascular diseases early and predict the health issues people might face based on their genetics.

8. Health Monitoring

Wearable health trackers – like those from FitBit, Apple, Garmin and others – monitors heart rate and activity levels. They can send alerts to the user to get more exercise and can share this information to doctors and AI systems for additional data points on the needs and habits of patients.

9. Healthcare System Analysis

In the Netherlands, 97% of healthcare invoices are digital. A Dutch company uses AI to sift through the data to highlight mistakes in treatments, workflow inefficiencies, and helps area healthcare systems avoid unnecessary patient hospitalizations.

IV. AI DEVICES - ML AND NLP

AI devices are grouped into three categories. The classical machine learning techniques, the more recent deep learning techniques and the NLP methods. The flow chart in figure 1describes the road map from clinical data generation, through NLP data enrichment and ML data analysis, to clinical decision making. The road map starts and ends with clinical activities. As powerful as AI techniques can be, they have to be motivated by clinical problems and be applied to assist clinical practice in the end.

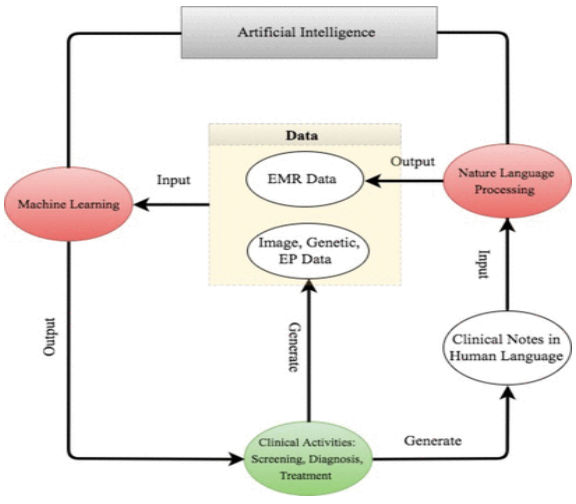

Figure 1

Classical ML

ML constructs data analytical algorithms to extract features from data. Inputs to ML algorithms include patient 'traits' and sometimes medical outcomes of interest. A patient's traits commonly include baseline data, such as age, gender, disease history and so on, and disease-specific data, such as diagnostic imaging, gene expressions, EP test, physical examination results, clinical symptoms, medication and so on. Besides the traits, patients' medical outcomes are often collected in clinical research. These include disease indicators, patient's survival times and quantitative disease levels, for example, tumour sizes.

Natural language processing- NLP

When large proportions of clinical information are in the form of narrative text, such as physical examination, clinical laboratory reports, operative notes and discharge summaries, which are unstructured and incomprehensible for the computer program, NLP is used. An NLP pipeline comprises two main components: (1) text processing and (2) classification. Through text processing, the NLP identifies a series of disease-relevant keywords in the clinical notes based on the historical databases. Then a subset of the keywords is selected through examining their effects on the classification of the normal and abnormal cases. The validated keywords then enter and enrich the structured data to support clinical decision making. The NLP pipelines have been developed to assist clinical decision making on alerting treatment arrangements, monitoring adverse effects and so on. NLP is used for reading the chest X-ray reports, would assist the antibiotic assistant system to alert physicians for the possible need for anti-infective therapy. NLP can automatically monitor the laboratory-based adverse effects and can help with disease diagnosis

V. AI TOOLS IN DREADFUL DISEASES

The three diseases Cancer, Neurology, Cardiology are leading causes of death; therefore, early diagnoses are crucial to prevent the deterioration of patients' health status .Also early diagnoses can be potentially achieved through improving the analysis procedures on imaging, genetic, EP or EMR, which is the strength of the AI system.

Cancer

AI is already being used to detect diseases, such as cancer, more accurately and in their early stages. According to the American Cancer Society, a high proportion of mammograms yield false results, leading to 1 in 2 healthy women being told they have cancer. The use of AI is enabling review and translation of mammograms 30 times faster with 99% accuracy, reducing the need for unnecessary biopsies. There is a great amount of research and drugs developed relating to cancer. There are more than 800 medicines and vaccines to treat cancer. This makes it difficult for the doctors to choose the right drugs for the patients. Microsoft is working on a project to develop a machine called "Hanover" which can memorize all the papers necessary to cancer and help predict which combinations of drugs will be most effective for each patient. AI is as good as trained doctors in identifying skin cancers and Myeloid leukemia, a fatal cancer where the treatment has not improved in decades is improving due to AI. AI is used to monitor multiple high-risk patients, and this is done by asking each patient numerous questions based on data acquired from live doctor to patient interactions.

Radiology

An ability to interpret imaging results may aid clinicians in detecting a minute change in an image that a clinician might accidentally miss. A study at Stanford created an algorithm that can detect pneumonia better than radiologists can. The radiology conference Radiological Society of North America has implemented a large part of its schedule to the use of AI in imaging. Recent advances make use of AI to describe

and evaluate the outcome of maxillo-facial surgery or the assessment of cleft patients therapy in regard to facial attractiveness or age appearance.

Cardiology

The proliferation of consumer wearables and other medical devices combined with AI is also being applied to oversee early-stage heart disease, enabling doctors and other caregivers to better monitor and detect potentially life-threatening episodes at earlier, more treatable stages.

Stroke

Stroke is a common and frequently occurring disease that affects more than 500 million people worldwide. It is the leading cause of death in China and the fifth in North America. Stroke, for 85% of the time, is caused by thrombus in the vessel called cerebral infarction. For early stroke prediction a movement-detecting device where two ML algorithms genetic fuzzy finite state machine and PCA were implemented into the device for the model building solution. The detection process included a human activity recognition stage and a stroke-onset detection stage. Once the movement of the patient is significantly different from the normal pattern, an alert of stroke would be activated and evaluated for treatment as soon as possible. In another method, a wearable device was formed for collecting data about normal/pathological gaits. The data would be extracted and modelled by hidden Markov models and SVM. For diagnosis of stroke, neuroimaging techniques, including MRI and CT, are important for disease evaluation. ML methods have also been applied to analyse CT scans from patients with stroke. Three ML algorithms were used to classify these two types by quantitative shape analysis, including linear discriminant analysis, artificial neural network and SVM. ML has also been applied for predicting and analysing the performance of stroke treatment. As a critical step of emergency measure, the outcome of intravenous thrombolysis (tPA) has strong relationship with the prognosis and survival rate. SVM is used to predict whether patients with tPA treatment would develop symptomatic intracranial haemorrhage by CT scan. They used whole-brain images as the input into the SVM, which performed better than conventional radiology-based methods.

VI. CONTRIBUTION OF LARGE COMPANIES TO HEALTHCARE

- IBM's Watson Oncology is working on AI applications in chronic disease treatment and for drug development and has made tremendous progress in oncology. Watson successfully identified the rare secondary leukaemia caused by myelodysplastic syndromes in Japan.
- Microsoft's Hanover project, analyzes medical research to predict the most effective cancer drug treatment options for patients, medical image analysis of tumor progression and the development of programmable cells.
- Google's DeepMind Health combines machine learning and systems neuroscience to build powerful general-purpose learning algorithms into neural networks that mimic the human brain. It uses AI to detect certain health risks through data collected via a mobile app and uses computer vision algorithms to detect cancerous tissues.
- Intel's venture capital uses AI to identify at-risk patients and develop care options.
- IDx's first solution, is the first and only FDA authorized AI system for the autonomous detection of diabetic retinopathy.
- Kheiron Medical developed deep learning software to detect breast cancers in mammograms.
- Medvice can access and store their Electronic Health Records (EHRs) over a decentralized blockchain and uses machine learning aided decision making to help physicians predict medical emergencies which require clinical assistance.
- Predictive Medical Technologies uses intensive care unit data to identify patients likely to suffer cardiac incidents.
- "Compassionate AI Lab" uses grid cell, place cell and path integration with machine learning for the navigation of blind people.
- Nimblr.ai uses an A.I. Chatbot to connect scheduling EHR systems and automate the confirmation and scheduling of patients.
- Infermedica's free mobile app Symptomate is the top-rated symptom checker in Google Play.
- Digital consultant apps like Babylon Health's GP at Hand, Ada Health, and Your.MD use AI to give medical consultation based on personal medical history and common medical knowledge. Users report their symptoms into the app, which uses speech recognition to compare against a database of illnesses.

CONCLUSION

The use of AI in health care decrease medical costs as there will be more accuracy in diagnosis and better predictions in the treatment plan as well as more prevention of disease. Future uses for AI include Brain-computer Interfaces (BCI) which are predicted to help those with trouble moving, speaking or with a spinal cord injury. The BCIs will use AI to help these patients move and communicate by decoding neural activates. Although the AI technologies are attracting substantial attentions in medical research, the real-life implementation is still facing obstacles. The first hurdle comes from the regulations. Current regulations lack of standards to assess the safety and efficacy of AI systems. To overcome the difficulty, the US FDA made the first attempt to provide guidance for assessing AI systems. AI will not replace healthcare workers but instead allow them more time for bed side cares and may avert healthcare worker burn out and cognitive overload and to diagnose more people with the need for fewer doctors as there is a shortage in many of the developing nations who do not have the proper resources. The goal of AI is to teach others in the world, which will then lead to improved treatment, and eventually greater global health.

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