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EDITORIAL

Artificial Intelligence (AI) in healthcare

Suraiya Jabin*

Department of Computer Science, Faculty of Natural Sciences, Jamia Millia Islamia, New Delhi-110025, India.

There's a famous quote "Machines will not replace physicians but physicians using AI will soon replace those not using it" [1]. AI is revolutionizing healthcare. Many hospitals world-wide are accumulating Electronic Health Records (EHR) of their patients in order to facilitate AI scientists to dig valuable patterns such as predicting length of hospital stay, rate of survival, susceptibility to catch any secondary infection, etc. Not only in the domain of patient care, other important healthcare domains of clinical diagnostics or drug discovery are not uninfluenced by use of AI techniques.

The simulation of human intelligence using either computer programs or machines is called Artificial Intelligence. The most common AI techniques fall under these 3 categories: use of knowledge, search techniques, and learning from experience in the form huge amount of data being accumulated in almost all domains affecting human life [2]. Origin of AI dates back to 1950 when British mathematician Allan Turing wrote a research paper with title "Computing machinery and intelligence". This paper introduced six disciplines viz. Natural Language Processing (NLP), Knowledge representation, Automated reasoning, Machine learning, and later on two more disciplines of Computer vision, Robotics added to it comprise most of the AI till today.

There are two notions of AI: Artificial Narrow Intelligence and Artificial General Intelligence. We have achieved the narrow sense in the view of existing state of the art image recognition [3-5] programs (e.g., AlexNet, GoogleNet, VGGNet, etc.), and other NLP models. Microsoft has developed an exciting application *Seeing AI*, a smartphone app that can verbally describe surroundings to blind people [6]. *AlphaFold2* cracked ages old biology problem of understanding how proteins fold showing bright future of structural biology [7]. Another exciting example of AI system is *Watch, Attend, and Spell* program, developed by researchers at Oxford University in collaboration with Google's DeepMind AI unit, is able to lip read up to 50% of muted videos [8]. Convolutional neural network is the algorithm which has been shown to defeat human intelligence in computer vision tasks but not in overall intelligence. A generalized AI program will be one that can exercise all aspects of human intelligence in one system. It can not only visualize surroundings, understand natural language, go for morning walk, follow a daily routine and aspirations, play football, take decisions, respond to abrupt situations, just like a human will do; all this in one AI based system is yet to be achieved.

***Corresponding Author**: Suraiya Jabin, Professor, Department of Computer Science, Faculty of Natural Sciences, Jamia Millia Islamia, New Delhi-110025, India; Email: sjabin@jmi.ac.in*

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Coming back to AI in healthcare, a number of EHR databases have been made publicly available by its creators after signing their term of use. One very popular example being MIMIC-III & IV ('Medical Information Mart for Intensive Care') is a large, single-center database [9-10] comprising de-identified information relating to patients admitted to critical care units at a large tertiary care hospital. This is an initiative of scientists from Boston's Beth Israel Deaconess Medical Center/Harvard Medical School and MIT started in 1999. MIMIC III dataset has recorded data of 40,000 patients for the duration 2001 to 2012. MIMIC IV has recorded data of more than 50,000 patients for duration 2008-2019. Such a huge dataset with daily basis medical record of patients' vitals, laboratory reports, and clinical information, no. of procedures, days of stay, comorbidities if any, etc. is a valuable resource to revolutionize healthcare. If every country starts ensuring collection and saving of EHR of patients as a routine job, and making it available for research purposes, health care will flourish to save every human life.

During last decade or so, the next generation sequencing (NGS) or High throughput DNA sequencing methodology has penetrated diverse application areas of biological sciences. Whole genome sequencing (WGS) has repurposed clinical diagnostics, drug discovery, predict drug efficacy and side effects, etc. [11]. WGS helps in detecting nearly all types of disease-causing genetic variants in one single test. FASTQ files are commonly used to store clinical WGS data with size ranging between a few mage bytes to several giga bytes. FASTQ files are given as input for programs that perform downstream analysis, such as alignment to a reference genome or de novo assembly. Instead of comparing clinical raw sequence with a reference genome, many AI based models have been trained to predict microbial outbreaks or multi-drug resistant (MDR) pathogens outbreak using deep learning techniques (e.g. Recurrent Neural Network) with word embeddings representing sequences. Hence, widespread adoption of clinical WGS offers comprehensible benefits in the area of diagnostic but significant contributions are yet to be seen in the area.

It takes at least 10-15 years for a drug to come to the market, and it's a costly process. AI has been successfully applied at various stages of drug discovery to simplify and aggravate the process [12]. AI has been applied in predicting 3D structure of target protein, predicting drug-target protein interactions, de novo drug design, designing bio specific & multi-target drug molecules, etc. It has also been applied in the prediction of reaction yield, new therapeutic use, toxicity, bioactivity, etc.

AI based systems are as smart as the data which is used to train them. One of the major drawbacks of AI based systems is under representation of certain groups. The under-represented groups just don't produce enough data that AI systems can train on. For example, during September 2021, there was a news on Facebook apologizing after its AI algorithm labelled black men as primates. Many popular stories in media suggest that AI has started taking control over humanity and will overpower humans any time soon. Many movies have also projected the same. In reality, AI researchers are still exploring the right balance of the train data in order to evolve a generalized AI model.

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