Application of AI in public health improvement: A Review

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Abstract

Over the years the Artificial Intelligence (AI)has proved to be a transformative tool proving to be revolutionizing in various sectors including medical and technological. Among all these the application that stands out is in the public segment proving to be a pinnacle. Starting from the development of MYSIN in the 1970s we have come up quite a long way in development of Support Vector Machines and Deep Neural Networks which are much more effective, accurate and specific. The application of AI in public health improvement encompasses several crucial factors including Disease diagnosis and treatment, risk prediction, gathering demographic data and combining it with disease spread for forecasting, as well as creation of a worldwide electronic dataset to make it easier of algorithms to access. Inspite of all these applicability, this method itself isn't flawless. Certain factors like data privacy, accuracy and ethical biasness continue to remain attached to it. Inspite of all these Artificial Intelligence presents a novel opportunity to bring about a renaissance in health care facilities across the globe.

Key Words: Artificial Intelligence, Public Health, Algorithms, Data Safety, Accuracy.

Introduction and a brief history

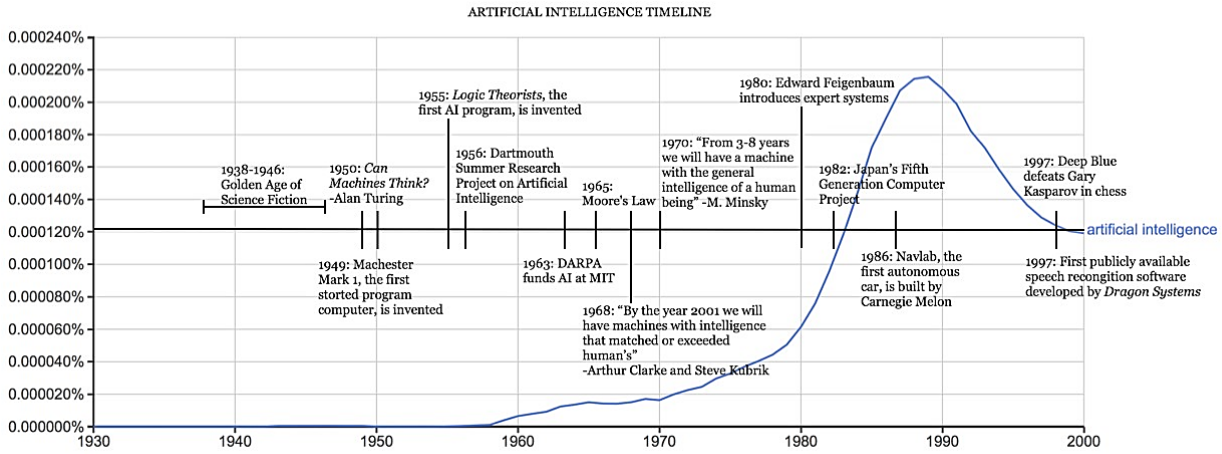

Fig 1. History of Artificial Intelligence. (Rockwell et al, 2017)

One of the greatest revolutions in the recent era has been the discovery of Artificial Intelligence. The birth of this AI dates back to the 1950s, where Alan Turing published Computer machinery and Intelligence. In 1956 John Mc Carthy and Marvin Minsky first coined the term Artificial Intelligence while organizing at a summer research project in Dartmouth. This laid the foundation to a large potential that was developed over the years through successes and failure stories and now has become an inseparable part of our life. (Rockwell et al, 2017)

The first instance of use of AI in health was in 1970s which saw remarkable developments in generation of new platforms like MYCIN, INTERNIST 1 and CASNET.

INTERNIST 1 was one of the first artificial intelligence-based expert systems ever created. The University of Pittsburgh began working on the development project in 1972. It ran under DEC2060 and PDP10 and was written in INTERLISP. For example, systemic lupus erythematosus was diagnosed with it, and the primary goal was localized disease diagnosis (JD Meyers, 1987). They were essential to the creation of another amazing piece of software called MYCIN. Taking care of blood infections was its main goal. Copeland, BJ, et al. (2018). Rutgers University created a more contemporary diagnosis in 1976. Model development, consultation, and database management were the three distinct components that made up the CASNET program.

Application in Disease Detection

Among all the uses of Artificial Intelligence in Public Health, probably the greatest application has been done in disease detection to increase the speed, effectiveness and accuracy of diagnosis(Figure 2).

One of the greatest revolutions in the use of AI in disease detection involves Artificial Neural Networks (ANNs) which serve as an underappreciated marvel, mirroring the human brain's predictive and pattern recognition abilities. They excel in tasks like predictive analysis of pathogenic infections. Of its greatest application was the development of CAD system to assess the brain images. (Lopez et al, 2011)

There is another highly successful model named Random Forest. Its working principle is based on sampling of instances followed by algorithm nondeterminism and it is, used this method for detection of Alzheimer's disease by processing a framework to preprocess MRI images of brain. (Dimitriadis et al, 2018)

Bagging, short for bootstrap aggregating, is a simple yet effective ensemble classification algorithm. It generates multiple models using bootstrap samples of the training set and combines them through unweighted voting for classification tasks. (Ebadi et al, 2017) A remarkable system as an application of this, named, Diffusion Tensor Imaging, presenting three different classification tasks namely, AD-CS, AD-MCI, and CS-MCI. (Subasi et al, 2020)

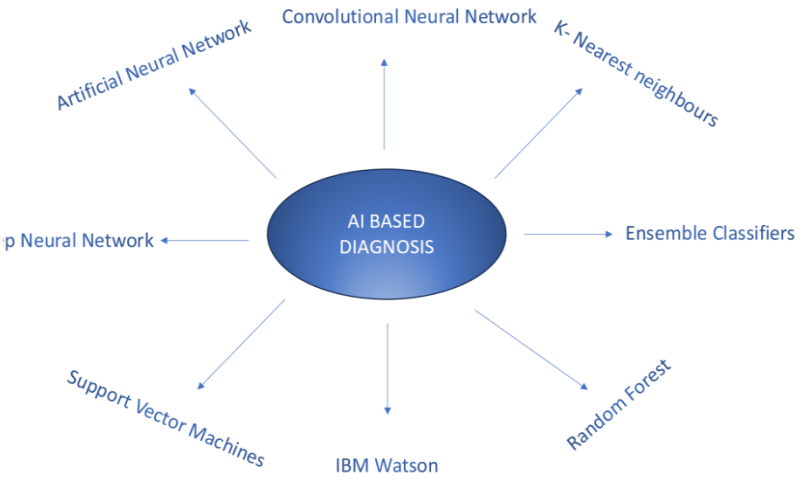

Figure 2. AI based diagnosis models

Risk Prediction

Over the years AI has been widely used in risk prediction of diseases, offering focused disease management and prevention. The method involved here is the auto analysis of electronic health data to predict the extent, likelihood and pattern of a particular disease. Till today this method remains yet to be explored properly. As mentioned earlier a well-developed method is IBM Watson, it can predict risk of heart attack with a stunning accuracy of 90% thus making people aware before a mishap happens. (Olawade et al, 2023)

Spatial Modelling

This probably is one the most useful methods used till date. Here the algorithms analyse the large-scale geographical data and satellite imagery as well demographic data of a disease to predict the area to spread of the disease. For instance, a special model was developed to map the spread of dengue accompanied the biting rates of dengue mosquitoes in the Guangzhou region of China(Guo et al, 2019). AI algorithms with predictive models can effortlessly analyse the demographics, environmental factors and clinical records to assess the high-risk population and the disease spreadofCOVID 19 (Gunasekeran et al, 2021).

Electronic Health Records

It is the digital clinical data of patients. It is the most important factor in the use of AI in public health. Just like we have Protein Data Bank containing all the structural data of proteins on which algorithms like Alpha Fold works, EHR consists of the clinical data accessible to AI, from where it can effortlessly draw an inference. This greatly boosts the effectivity of algorithms. AI models can easily go through a large volume of EHR to come to a conclusion and asses the degree of spread of a disease and its risk factors. To identify the medical terms there is system called NLP which consists of Named Entity Recognition. To gain valuable insights for diagnosis, in the recent years AI has been combined with EHR and NLP (Natural Language Processing). (Olawade et al, 2023)

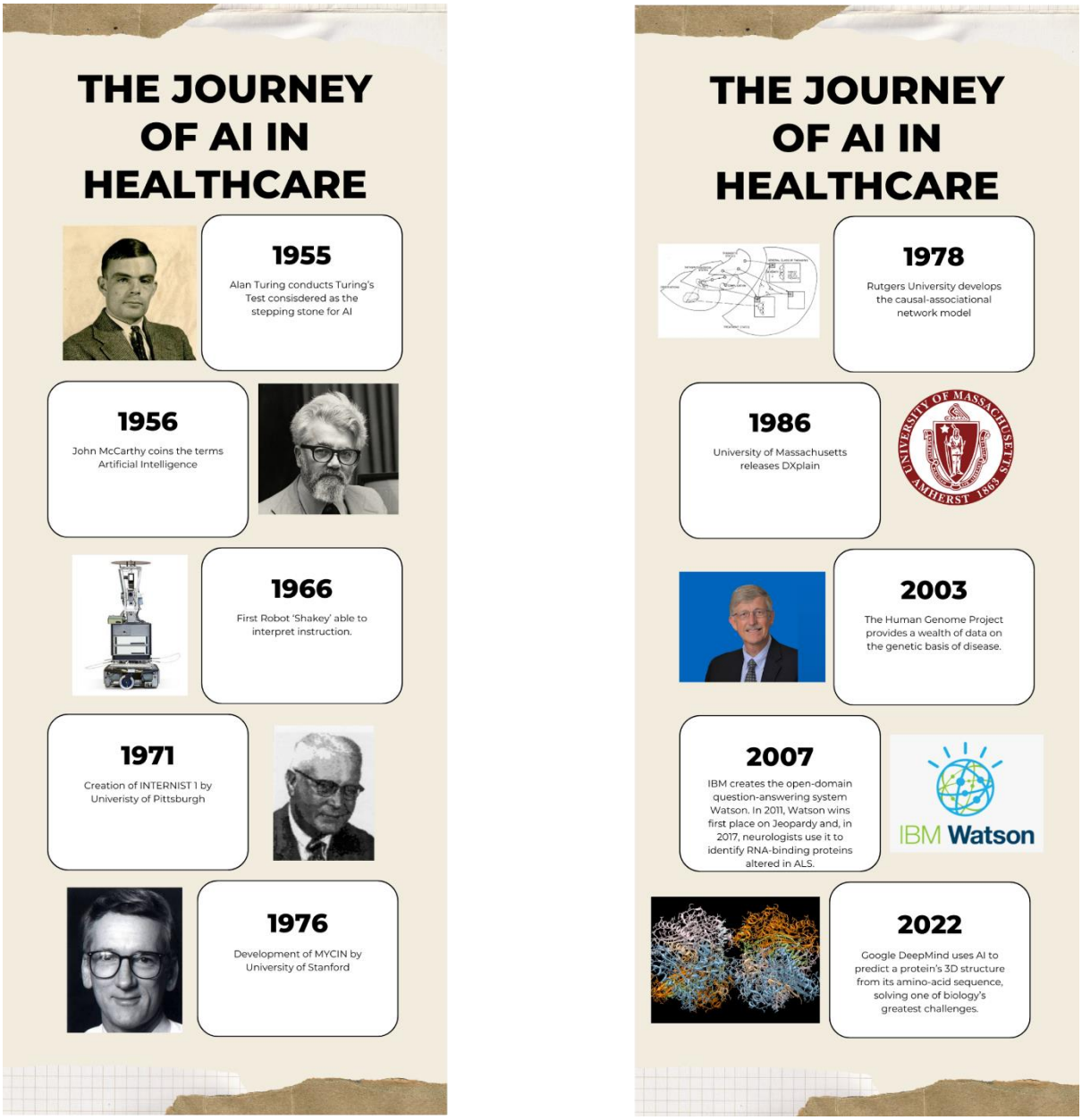

Figure 3: Journey of AI in public health care

Conclusion

Since its inception in the 1950s, artificial intelligence has evolved into an indispensable force, permeating virtually every facet of our modern world. Yet, perhaps nowhere is its impact more profound than in the realm of healthcare. From rudimentary artificial neural networks

to cutting-edge algorithms like Deep Neural Networks, Convolutional Neural Networks, Support Vector Machines, and IBM Watson, AI has catalysed a renaissance in healthcare delivery and innovation(Figure 3).

However, amidst its transformative potential lies a shadow of concern: data privacy. Ethical dilemmas surrounding algorithmic bias, which can disproportionately affect vulnerable populations, persist as significant hurdles. Furthermore, scepticism within the healthcare community regarding the reliability and accuracy of AI methods continues to fuel debate.

Nevertheless, by instituting dedicated committees for data security and advancing the precision, effectiveness, and specificity of AI-driven algorithms, we can forge a new path forward. In doing so, we stand to revolutionize disease prediction, diagnosis, and treatment, paving the way for a future where healthcare is not only more advanced but also more just and equitable for all.

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