

Application of Artificial Intelligence Systems to Improve Healthcare Delivery in Africa

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Introduction

Artificial Intelligence (AI) and associated technologies hold great promise to rapidly improve healthcare delivery in under resourced environments. Africa stands to greatly accelerate and improve its health standards with the application of AI. The advent of mobile technology, Electronic Medical Record Systems (EMRs) and cloud computing have laid a pathway for delivery of advanced artificial intelligence technologies that have the potential of closing the gap in healthcare outcomes between Africa and the rest of the world [1]. What constitutes artificial intelligence in healthcare has been broadly defined by diverse authors. Broadly speaking, artificial intelligence is a branch of computer science that deals with simulation of intelligent behavior in computers [2]. Often, when the term artificial intelligence is mentioned in general use, it is usually referring to the ability of a machine or computer to represent the human mind and perform intellectual task such that it simulates human performance [3]. In practical applications that involve artificial intelligence, usually one aspect of simulated human intelligence is focused on to achieve a specified outcome.

Background

Contemporary use of artificial intelligence technologies in health care can be generally grouped into the following categories [4,5].

Expert systems

These are also known as knowledge-based systems and are programs that have expert level of competence in solving specific healthcare problems, therefore stimulating a healthcare expert.

Machine learning

This is a computer-based method for automating data analysis by using algorithms that automatically identify patterns in data and learn from them. Deep learning is a subset of machine learning that uses brain-like logical structure algorithms called artificial neural networks to achieve the task, therefore allowing for processing of unstructured data like images, sounds and text.

Natural Language Processing (NLP)

This allows computers to read and interpret text in the way that is naturally written for humans and identify keywords and phrases, then use these to determine the meaning of the text, identify patterns and analyze the relationships between these patterns.

Automated planning and scheduling

Also called AI planning, this is used to automatically organizing and prioritizing activities to increase efficiency in achieving a desired outcome.

Image and signal processing

These are AI systems that are used to process data from images, sounds, motion. In literature, earliest deployment of artificial intelligence in healthcare delivery in Africa was in the mid-1980s, when it was deployed in Kenya to improve the quality of healthcare worker patient interaction. This program resulted in an increased number of symptoms elicited from the patient [6]. Subsequently, there was an expert system artificial intelligence program deployed in Egypt in 1986 to improve detection of common and potentially blinding eye conditions [7].

Contemporary Use of AI Systems

More recently, there are numerous examples of the various types of AI systems discussed above, being deployed in under-resourced environments in Africa. For instance, the Council for Science and Industrial Research (CSIR) in South Africa used an expert AI system to identify favorable environmental preconditions that would lead to cholera outbreaks in southern Africa. The methodology was reliant on capturing expert knowledge, historic data but integrated climatic and biophysical parameters with epidemiological data to produce a fuzzy surface of outbreak risk potential [8]. There is widespread availability of mobile technology in healthcare delivery in various settings in Africa [9]. This has allowed for powerful cloud computing systems to be possible even in remote and resource poor settings that would otherwise not be available locally. This has also made it possible for advanced artificial intelligence systems to piggyback on the existing framework to deliver high quality healthcare in remote settings. A good example of how deep penetration of mobile phone technology has paved the way for artificial intelligence application health care in Africa is an AI program that was deployed to predict birth asphyxia using a mobile phone application in Nigeria. The application detects the birth cry of a child, and can then identify children likely to be experiencing birth asphyxia [10]. Community healthcare workers are the backbone of health care in Africa. This is especially true in rural communities where community healthcare workers often provide the bulk of care outside the standard healthcare infrastructure. Usually, these community healthcare workers have travel from community to community or from house to house, covering large distances. To address the problem of ensuring community health workers visit the right household or the right community at the best time to maximize engagement with patients, a scheduling artificial intelligence program has been used in Africa to optimize community health care workers visits [11]. Deep learning programs can help diagnose medical conditions especially where highly trained clinical staffs are unavailable. In the Copper belt province of Zambia, a deep learning artificial intelligence model consisting of a combination of two convolutional neural networks was used in a population-based diabetic retinopathy screening program to identify referable vision threatening diabetic retinopathy [12]. Machine learning programs have also been used to diagnose tuberculosis from chest X rays in Zambia and Tanzania [13-15]. When it comes to natural language processing using AI systems, many African languages have received minimal attention. However, new neural network models are starting to focus attention on African languages. For instance, a new neural network model called AfriBERTa15, works specifically with eleven African languages including Afaan Oromoo, Amharic, Gahuza (a mixed language containing Kinyarwanda and Kirundi), Hausa, Igbo, Nigerian Pidgin, Somali, Swahili, Tigrinya and Yoruba spoken collectively by more than 400 million people [16,17].

Conclusion

When it comes to deployment of new technologies, Africa may oftentimes be perceived as lagging behind the rest of the world. However, because of the nature of artificial intelligence systems used in healthcare, they are uniquely suited for the challenge of delivering healthcare to remote and under resourced settings. This has led to the deployment of many programs across Africa in attempt to specifically address these challenges. Nevertheless, even though AI systems may hold great promise for the future of in Africa, the reality of the situation is that only a handful of African nations have embraced and pursued artificial intelligence deployment

in healthcare. These countries are notably Kenya, South Africa, Nigeria, Ghana, and Ethiopia. Even in these countries, many healthcare providers are unaware that these systems exist and are currently being used in their respective countries. Without the availability of needed infrastructure for secure data collection with data privacy, education, and good governance, the dream of artificial intelligence leapfrogging healthcare in Africa into the future may not be realized.

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