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EYEING ARTIFICIAL INTELLIGENCE IN MEDICINE: A MINI REVIEW

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The word 'Eye' in the headline of regular news item never fails to catch attention and it certainly has been an all too frequent occurrence in last few months. Variously described in literature as having their own vocabulary, their own language and their own expression, eyes give away a lot about our mind, body and soul. The ongoing insatiable urge to peep deep into into its hidden treasures by authors, doctors, scientists and researchers, is therefore not surprising!

Doctors have long seen the retinal vasculature to get a bird's eye view of the condition of tiny blood vessels of the body- long before the diseases such as hypertension or diabetes manifested in louder symptoms and signs of havoc. They have observed the eye movements in comatose patients as clues to the underlying affliction of the brain. Body language experts have held onto eye movements as give-away's of an individual's thought processes - the Roving Eye of the flirt and the Shifty eyes of deceiver, are all too well known.

'Artificial Intelligence' is the new buzz-word, the newest accomplice in probing the all powerful human eye. Software programs called 'deep learning' enable the machine to learn its own features and make correlations and predictions by making sense of heaps of data on patients, diseases and complex diagnoses.

The first mention of the potential of application of artificial intelligence to Medicine was made by a computer scientist from Stanford University in 1977 (1) . Close to 40 years hence, we have seen the sapling from the seed. Today, market research by McKinsey estimates that "big data and machine learning in pharma and medicine could generate a value of up to $100B annually", based on better decision-making, optimized innovation, improved efficiency of research/clinical trials, and coordinated efforts of biologists, computational engineers and doctors (2).

A technological advancement in detection of deception, called EyeDetect, first launched in 2014 has already replaced the polygraph exam- an erstwhile gold standard for detecting lies, by being more affordable, less biased version and used in 34 countries as part of job interviews and corporate and criminal investigations (3).

In April 2018, The US FDA permitted marketing of IDx-DR, the first diagnostic medical device based on artificial intelligence for early detection of diabetic retinopathy, a leading cause of vision loss among diabetics. IDx-DR makes a screening decision based on retinal images taken with a retinal camera called the Topcon NW400, and without the need for a clinician to interpret the image or results, which makes it usable by health care providers who may not normally be involved in eye care. IDx-DR was reviewed under the FDA's De Novo premarket review pathway, a regulatory pathway for some low- to moderate-risk devices that are novel and for which there is no prior legally marketed device. IDx-DR was granted 'Breakthrough Device' designation, meaning the FDA provided intensive interaction and guidance to the company on efficient device development, to expedite evidence generation and the agency's review of the device (4). This has opened flood gates of motivation and opportunity for other aspiring device-makers and bio medical engineers to advertise their novel offerings and expedite development.

NVIDIA Corporation is developing deep learning algorithms that spot advanced macular degeneration (AMD) and macular edema, a condition that damages central vision to detect signs of disease that doctors miss, or speed up diagnosis so doctors can start treatments sooner than they usually do (5).

Verily-Google venture is using machine learning to predict risks of heart diseases by scanning the fundus of the eyes. It is said that the algorithm-based prediction is as accurate result as other contemporary methods and although not yet ready for prime time, it will make it quicker and easier for doctors to analyze a patient's heart disease, without any blood test (6).

More recently, neuroscientists have measured the variability of an 'intense visual focus', its' spatial coordinates and timeframes of attention and validated their importance in sporting performance and errors. The 'Quiet eye of the athlete' is a catchy new description for the long recognized attribute of the ability of focussed gaze to enhance chances of success, something that distinguishes a seasoned player from a novice. Elite sports trainers are now espousing the concept to train player's eyes to judge, anticipate and perform with speed and mental fortitude, regardless of physical prowess (7). Indeed, one could surmise that Arjuna's quiet-eye could well be the secret to his immense concentration and ability to tune out the background noise when he used his archery to his advantage in Mahabharata!

Use of similar eye-tracking-methods using Machine learning approach has found application in behavioural sciences to validate self reported personality traits inferred from participant interviews. It is hoped that such research would provide insights into how the eye movements fit into human-non verbal behaviour. Indeed, bio-medical engineers are looking at the practical applications of the new found knowledge in social robotics (8).

Enabling machine intelligence is an exhilarating trend. At the moment, it seems like a healthy feedback cycle of human inputs into machines to make human effort more efficient. It is postulated that Machine learning will become an indispensable tool for clinicians seeking to truly understand their patients. As patients' conditions and medical technologies become more complex, its role will continue to grow, and clinical medicine will be challenged to grow with it (9). Harnessing the power of the mind through the computational visual approach is just one of the many possibilities of scientific endeavour.

However, the thought of extrapolation of human knowledge to empower machines rings a bell. In fact, the threat lansdcape for artificial intelligence has already been mapped and high level recommendations made in a 98 page report by 25 technical and public policy researchers from Cambridge, Oxford, and Yale universities along with privacy and military experts (10). Threats to digital, physical and political security, by allowing for large-scale, automated, finely targeted, highly efficient attacks. The report focuses on plausible developments within five years and calls for regulatory and policy safegaurds to rein in the potential of damage.

Tesla CEO, Elon Musk, an AI investor is one of its biggest critics. Speaking at the World Government Summit in February 2017, he said that humans must 'augment' their abilities to stay relevant in a future soon to be dominated by sophisticated AI. His plans and work on probable "neuroprosthetics" to allow communication of complex ideas telepathically and give us additional cognitive (extra memory) or sensory (night vision) abilities as well as injectable mesh-like "neural lace" to fit on one's brain to give it digital computing capabilities, seems like Sci-Fi fiction to the uninitiated. Such a merger of biological intelligence and machine intelligence will apparently make us what is called 'Cyborgs', the surviving species of the future- adding yet another tongue twister to our already overloaded vocabulary!

Technology continues to enthuse till it fails us. Caution is the word. A fine line exists between technology-in-aid and technology-in power. We must guard against artifical intelligence to assist, to empower and ultimately to make human faculties redundant. As quoted in H.G Wells epic fictional work-The Time Machine-

"It sounds plausible enough to-night," said the Medical Man; "but wait until to-morrow. Wait for the commonsense of the morning." (1.73)

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