I Heard of Artificial Intelligence: Will it Help Our Patient?
(A Futuristic Idea To Predict Stroke)

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What is Artificial Intelligence?

Artificial Intelligence (AI) is a constellation of technologies that enable machines to act with higher levels of intelligence and emulate the human capabilities of sense, comprehend and act. Figure 1 below incorporated from a Discussion Paper - National Strategy for Artificial Intelligence (https://smartnet.niua.org/content/2bc031e8-955b-46dd-a722-6513236d9635) explains Artificial Intelligence.

Artificial Intelligence has the potential to provide large incremental value to a wide range of sectors globally including: Healthcare, Agriculture, Smart Mobility, Retail, Manufacturing, Energy, Smart Cities, Education

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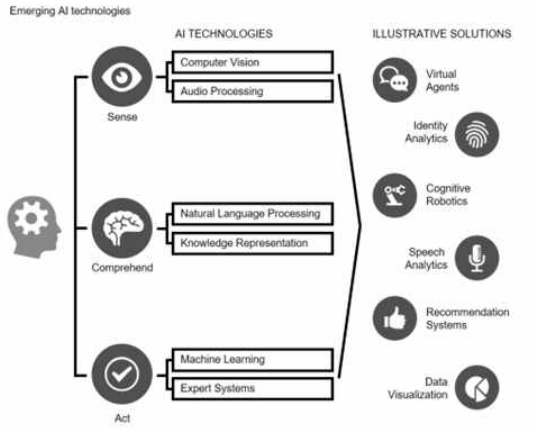
Figure 1: What is Artificial Intelligence



What is Feature Engineering?

In medical image classification, classical machine learning, as a subfield of AI, requires "feature engineering", which means that the machine learns to look for and identify "specific predefined features or patterns" in the images (say retinal fundus photographs). The risk of course is that there can be a high error rate because of the great variations of these "features" - that the machine would learn to look for and also their morphologies in various diseases.[1]

What Is Machine Learning?

Machine learning is enabling computers to make successful predictions or judgements by repeatedly learning existing representative data. Thus, machine learning often requires a large number of "training data" already labelled by relative authoritative experts (doctors)

to build an algorithm (model). Once established; the algorithm needs more data to increase accuracy. The data mainly includes two parts; training data set and validation data set.[2]

The process of machine learning automatically detecting a disease mainly includes:[3]

- Firstly, it's necessary to collect a large number of images, and experts (doctors) have to label the characteristic lesions (features). This is fundamental but very crucial.
- Secondly, computers extract these "features" of disease through a particular programme based on the input of marked images and learns it. A given image can be distinguished from other kind of image based on these features.
- Finally, this needs to be validated before use.

Our Futuristic Idea to Predict Stroke Using Artificial Intelligence

Artificial intelligence is being used in Ophthalmology mainly for diabetic retinopathy and glaucoma. There is an overwhelming evidence in literature that hypertension (blood pressure) represents the first risk factor for stroke and that prevention of stroke benefits the most from blood pressure lowering. But it remains difficult to predict among those with hypertension; who will develop a stroke. There is increasing evidence that small-vessel disease is a systemic vascular disorder that can be a major cause of stroke.[4]

Some studies have shown that certain retinal micro-vascular abnormalities are associated with stroke and might act as surrogate markers for cerebral small-vessel diseases.[5]

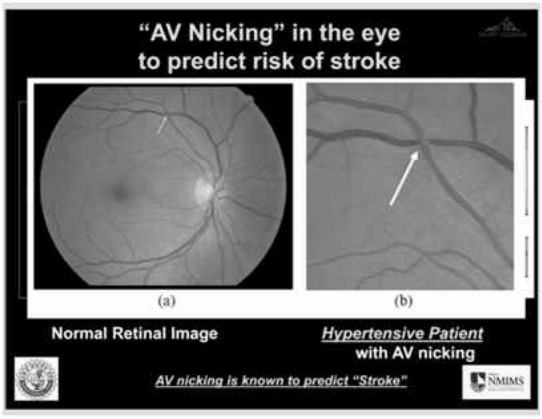
Persons with hypertension and increasing severity of hypertensive retinopathy were associated with an increased risk of incident stroke, including cerebral infarction.[6]

The retinal blood vessels changes can thus be "biomarkers" for cerebral microvascular diseases diagnosis and monitoring the retinal blood vessels is more than necessary as they share common anatomical and physiological features with cerebral arterioles.[7]

Among persons with hypertension without diabetes, hypertensive retinopathy is associated to an increased long-term risk of stroke, independent of other vascular risk factors. Furthermore, among those who have seemingly good control of hypertension, persons with hypertensive retinopathy are nevertheless at an increased risk of developing cerebral infarction. These findings suggest that retinal examination may be valuable for assessment of stroke risk in patients with hypertension.[6] There are at least 3 studies in major world literature that show that specifically retinal arterio-venous nicking (AV Nicking) and onwards has an association with stroke.[8,9,10] This simple sign of "AV Nicking" shown in Figure 2 below is seen in the eye of a patient is an important bio-marker to predict much more dangerous disease like stroke.

This sign is normally "seen" by eye doctors in patients. If technicians can be trained to photograph the eye, then this sign can be seen in the photographs by the

eye doctors who can access the image which is Telemedicine - Current Concept. If technicians can be trained to photograph the eye, and further our software can be used to process the image and that software "looks" for "AV Nicking" that would be Artificial Intelligence - Future Concept. Thus, a large number of patients could be screened in a short time of a few seconds using Artificial Intelligence. Those patients in whom AI specifically detects "AV Nicking" can be screened by the eye specialists for Hypertensive Retinal Changes and further by physicians, if required for the risks of more serious events like stroke or paralysis. Thus, there is the possibility of developing an algorithm based on clinical chronological data to predict future disease progression.



Limitation of Artificial Intelligence

Artificial Intelligence is not without limitations. Forming an algorithm needs a lot of computational cost and training experience. That means AI may be just useful for the diseases with a high morbidity. For rare diseases, it may not be available. The computer recognises a structure or a feature mechanically, so AI cannot or is unlikely to completely identify a disease independent of human (doctors) intervention. A small portion of feature and variation that look like unusual will be missed. This means AI can pick out the majority of people with a kind of disease, not all of them. The characteristics of a disease and parameters of an algorithm differ from tasks to tasks. Finally, if the relationship between input and expected output materials is complex, the machine will probably not be able to build a model. What's more important is that it may cause a mistake. AI can really efficiently conduct a task, but human intervention is thus absolutely essential during the process.[3]

Take Home Message

What doctors can expect is more help into the healthcare system, by "Filling up the cracks" - Making more unsuspecting people aware that they may be harbouring a problem. An already over-burdened system would then have a way to channelise those patients "needed to be seen" by specialists to them. The role of any AI machine would however end at just "being an aid" to screening the general population and help diagnose disease and is not good or not meant at all to make medical decisions afterwards - which would depend on the doctor-patient interaction.

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Flexible sigmoidoscopy screening: is once enough?

Over the past three decades, several methods to screen for colorectal cancer, and to detect, remove, or both, colorectal cancer precursorsnamely, adenomatous polyps-have been developed.

From a public health perspective, the updated findings of a reduction in the overall colorectal cancer incidence and mortality through to 17 years raises the issue of whether once-only flexible sigmoidoscopy might a reasonable screening strategy.

In the absence of a subsequent Faecal occult blood test FOBT (or Faecal immunochemical test FIT) testing programme, screening programme planners need to assess the probable added benefit of a second flexible sigmoidoscopy screen, say 10-15 years after the first. The results of Atkin and colleagues' study suggest that such added benefit might will be restricted in terms of additional reductions in colorectal cancer incidence or mortality.

Flexible sigmoidoscopy screening, even once only, is a resource-conserving strategy that, as shown in the study by Atkin and colleagues, seems to achieve much of the potential of colorectal cancer prevention, but one which also misses a substantial fraction of potentially preventable or curable cancers.

Paul F Pinsky, The Lancet, 2017, Vol 390, 1275-1276