PUBLIC RELEASE: 22-FEB-2018

Artificial intelligence can diagnose and triage retinal diseases

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VIDEO: THIS VIDEO ABSTRACT DEPICTS HOW ARTIFICIAL INTELLIGENCE TAKES ON DISEASE DIAGNOSIS IN A NEW STUDY FROM ZHANG AND COLLEAGUES WHERE A DEEP-LEARNING FRAMEWORK IS UTILIZED TO DEVELOP AN IMAGE-BASED DIAGNOSTIC... **view more ›**

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While we might trust virtual assistants to give us directions or recommend as spot for lunch, trusting artificial intelligence (AI) with something as important as a medical diagnosis is a step that many people are not yet willing to take. A team of scientists in the United States and China aim to change that. In the February 22 issue of *Cell*, they describe a platform that uses big data and AI not only to recognize two of the most common retinal diseases but also to rate their severity. It can also distinguish between bacterial and viral pneumonia in children based on chest X-ray images.

"Macular degeneration and diabetic macular edema are the two most common causes of irreversible blindness but are both very treatable if they are caught early," says senior author Kang Zhang, a professor of ophthalmology at the University of California, San Diego's Shiley Eye Institute. "Deciding how and when to treat patients has historically been handled by a small community of specialists who require years of training and

are concentrated mostly in urban areas. In contrast, our AI tool can be used anywhere in the world, especially in the rural areas. This is important in places like China, India, and Africa, where there are relatively fewer medical resources."

The platform looked at more than 200,000 optical coherence tomography (OCT) images collected with a noninvasive scan that uses light waves to image the layers of the retina. Earlier studies have used machine learning to study retinal images, but the authors of the new study say their platform goes a step further by using a technique called transfer learning. This is a type of machine learning in which general knowledge related to classification can be transferred from one disease area to another and can enable the AI system to learn effectively with a much smaller dataset than traditional methods. In addition to making a medical diagnosis, this AI platform also can make referral and treatment recommendations, which is another step that goes beyond previous studies.

The researchers also used occlusion testing, which allowed them to show areas of greatest importance when reviewing the scan images. "Machine learning is often like a black box, where we don't know exactly what is happening," Zhang explains. "With occlusion testing, the computer can tell us where it is looking in an image to arrive at a diagnosis, so we can figure out why the system got the result it did. This makes the system more transparent and increases our trust in the diagnosis."

In the study, the researchers compared the diagnoses from the computer with those from five ophthalmologists who reviewed the scans. "With simple training, the machine could perform to the level of a well-trained ophthalmologist. It could generate a decision on whether or not the patient should be referred for treatment within 30 seconds and with more than 95% accuracy," Zhang says.

He explains that diagnosing and treating retinal diseases normally involves visiting a general medical doctor or an optometrist, then a general ophthalmologist, and finally a retina specialist. This referral process can waste valuable time and resources for a disease in which prompt treatment can mean the difference between going blind or retaining sight. "Having an automated diagnosis could enable patients who would benefit from treatment to see a specialist and get that treatment much sooner and change outcomes," he says.

Zhang estimates that the test will be only a fraction of the current cost. "In addition to economic benefit, there are significant non-economic benefits in increased personal and society productivity regarding a patient's wait time spent to see a doctor and better access to care in remote areas," he says.

The researchers also applied the tool to childhood pneumonia. By reviewing chest X-rays, the computer was able to determine the difference between viral and bacterial pneumonia with greater than 90% accuracy. Viral pneumonia is treated mainly with supportive care, whereas bacterial pneumonia requires swift initiation of antibiotic treatment. This showed that the tool is adaptable and can be used effectively with multiple types of medical images.

Zhang says this technology has many other potential applications, such as distinguishing between cancerous and noncancerous lesions on CT scans or MRIs, and his group has made their data and tools open source so that other groups can use it. "If we all work together as a community, we can develop better and better tests

with higher computational power," he says. "The future is more data, more computational power, and more experience of the people using this system, so that we can provide the best patient care possible, while still being cost effective."

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This study was funded by the Richard Annesser Fund, the Michael Martin Fund, the Dick and Carol Hertzberg Fund, the National Basic Research Program of China, and the Natural Science Foundation of China.

Cell, Kermany et al. "Identifying Medical Diagnoses and Treatable Diseases by Image-Based Deep Learning." http://www.cell.com/cell/fulltext/S0092-8674(18)30154-5

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Media Contact

Joseph Caputo
jcaputo@cell.com
617-335-6270

@CellPressNews

http://www.cellpress.com