

World-first AI foundation model for eye care to supercharge global efforts to prevent blindness

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Researchers at Moorfields Eye Hospital and UCL Institute of Ophthalmology have developed an artificial intelligence (AI) system that

has the potential to not only identify sight-threatening eye diseases but also predict general health, including heart attacks, stroke, and Parkinson's disease.

RETFound, one of the first AI foundation models in health care, and the first in ophthalmology, was developed using millions of eye scans from the NHS. The research team are making the system open-source: freely available to use by any institution worldwide, to act as a cornerstone for global efforts to detect and treat blindness using AI. This work has been published in *Nature*.

Progress in AI continues to accelerate at a dizzying pace, with excitement being generated by the development of "foundation" models such as ChatGPT. A foundation model describes a very large, complex AI system, trained on huge amounts of unlabeled data, which can be fine-tuned for a diverse range of subsequent tasks.

RETFound consistently outperforms existing state-of-the-art AI systems across a range of complex clinical tasks, and even more importantly, it addresses a significant shortcoming of many current AI systems by working well in diverse populations, and in patients with rare disease.

Senior author Professor Pearse Keane (UCL Institute of Ophthalmology and Moorfields Eye Hospital) said, "This is another big step towards using AI to reinvent the [eye examination](#) for the 21st century, both in the U.K. and globally. We show several exemplar conditions where RETFound can be used, but it has the potential to be developed further for hundreds of other sight-threatening eye diseases that we haven't yet explored."

"If the U.K. can combine high quality [clinical data](#) from the NHS, with top computer science expertise from its universities, it has the true potential to be a world leader in AI-enabled health care. We believe that

our work provides a template for how this can be done."

AI foundation models have been called "a transformative technology" by the U.K. government in a [report published earlier this year](#), and have come under the spotlight with the launch in November 2022 of ChatGPT, a foundation model trained using vast quantities of text data to develop a versatile language tool.

Taking a comparable approach with eye images in a world-first, RETFound has been trained on millions of retinal scans to create a model that can be adapted for potentially limitless uses.

One of the key challenges when developing AI models is the need for expert human labels, which are often expensive and time-consuming to acquire. As demonstrated in the paper, RETFound is able to match the performance of other AI systems while using as little as 10% of human labels in its dataset. This improvement in label efficiency is achieved by using an innovative self-supervising approach in which RETFound masks parts of an image, and then learns to predict the missing portions by itself.

RETFound could help improve diagnosis of some of the most debilitating eye diseases, including diabetic retinopathy and glaucoma, and predict systemic diseases such as Parkinson's, stroke and heart failure. Identifying [general health](#) issues through the eyes is an emerging science called "oculomics"—a term coined in 2020 by Professor Alastair Denniston, one of the paper's co-authors. The eye is a "window" into our overall health, providing a non-invasive look at the nervous system. Understanding the eye-body relationship is key to approaching complex diseases and the overall problems associated with aging.

In addition, RETFound has shown that it is equally effective in detecting disease across diverse populations. Lead author of the study, Ph.D.

student Yukun Zhou (UCL Center for Medical Image Computing, UCL Medical Physics & Biomedical Engineering, and Moorfields Eye Hospital), said, "By training RETFound with datasets representing the ethnical diversity of London, we have developed a valuable base for researchers worldwide to build their systems in health care applications such as ocular disease diagnosis and systemic disease prediction."

RETFound was trained with a curated dataset of 1.6 million images from Moorfields Eye Hospital. This used AI tools and infrastructure provided by INSIGHT, the NHS-led health data research hub for eye health based at Moorfields, and the world's largest bioresource of ophthalmic data. The hub's powerful computing and AI capabilities evolved from a 2016 research collaboration between Moorfields and DeepMind, now Google DeepMind.

The research team, led by Yukun Zhou and Professor Pearse Keane of Moorfields and UCL, have made the model freely available for use on GitHub. Researchers worldwide, such as Singapore and China, have been using RETFound in their novel investigation into eye diseases.

More information: Yukun Zhou, A foundation model for generalizable disease detection from retinal images, *Nature* (2023). [DOI: 10.1038/s41586-023-06555-x](https://doi.org/10.1038/s41586-023-06555-x).
www.nature.com/articles/s41586-023-06555-x

GitHub: github.com/rmaphoh/RETFound_MAE

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