Artificial intelligence model can detect Parkinson's from breathing patterns

An AI-developed device with the appearance of a Wi-Fi router uses a neural network to discern the presence and severity of one of the fastest-growing neurological diseases in the world.

Alex Ouyang | Abdul Latif Jameel Clinic for Machine Learning in Health
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PRESS INQUIRIES

A new neural network trained by MIT PhD student Yuzhe Yang and postdoc Yuan Yuan assesses whether or not someone has Parkinson's from their nocturnal breathing.
Image courtesy of researchers.

Parkinson's disease is notoriously difficult to diagnose as it relies primarily on the appearance of motor symptoms such as tremors, stiffness, and slowness, but these symptoms often appear several years after the disease onset. Now, Dina Katabi, the Thuan (1990) and Nicole Pham Professor in the Department of Electrical Engineering and Computer Science (EECS) at MIT and principal investigator at MIT Jameel Clinic, and her team have developed an artificial intelligence model that can detect Parkinson's just from reading a person's breathing patterns.

The tool in question is a neural network, a series of connected algorithms that mimic the way a human brain works, capable of assessing whether someone has Parkinson's from their nocturnal breathing — i.e., breathing patterns that occur while sleeping. The neural network, which was trained by MIT PhD student Yuzhe Yang and postdoc Yuan Yuan, is also able to discern the severity of someone's Parkinson's disease and track the progression of their disease over time.

Yang is first author on a new paper describing the work, published today in *Nature Medicine*. Katabi, who is also an affiliate of the MIT Computer Science and Artificial Intelligence Laboratory and director of the Center for Wireless Networks and Mobile Computing, is the senior author. They are joined by Yuan and 12 colleagues from Rutgers University, the University of Rochester Medical Center, the Mayo Clinic, Massachusetts General Hospital, and the Boston University College of Health and Rehabilitation.

Over the years, researchers have investigated the potential of detecting Parkinson's using cerebrospinal fluid and neuroimaging, but such methods are invasive, costly, and require access to specialized medical centers, making them unsuitable for frequent testing that could otherwise provide early diagnosis or continuous tracking of disease progression.

The MIT researchers demonstrated that the artificial intelligence assessment of Parkinson's can be done every night at home while the person is asleep and without touching their body. To do so, the team developed a device with the appearance of a home Wi-Fi router, but instead of providing internet access, the device emits radio signals, analyzes their reflections off the surrounding environment, and extracts the subject's breathing patterns without any bodily contact. The breathing signal is then fed to the neural network to assess Parkinson's in a passive manner, and there is zero effort needed from the patient and caregiver.

"A relationship between Parkinson's and breathing was noted as early as 1817, in the work of Dr. James Parkinson. This motivated us to consider the potential of detecting the disease from one's breathing without looking at movements," Katabi says. "Some medical studies have shown that respiratory symptoms manifest years before motor symptoms, meaning that breathing attributes could be promising for risk assessment prior to Parkinson's diagnosis."

The fastest-growing neurological disease in the world, Parkinson's is the second-most common neurological disorder, after Alzheimer's disease. In the United States alone, it afflicts over 1 million people and has an annual economic burden of $51.9 billion. The research team's algorithm was tested on 7,687 individuals, including 757 Parkinson's patients.

Katabi notes that the study has important implications for Parkinson's drug development and clinical care. "In terms of drug development, the results can enable clinical trials with a significantly shorter duration and fewer participants, ultimately accelerating the development of new therapies. In terms of clinical care, the approach can help in the assessment of Parkinson's patients in traditionally underserved communities, including those who live in rural areas and those with difficulty leaving home due to limited mobility or cognitive impairment," she says.

"We've had no therapeutic breakthroughs this century, suggesting that our current approaches to evaluating new treatments is suboptimal," says Ray Dorsey, a professor of neurology at the University of Rochester and Parkinson's specialist who co-authored the paper. Dorsey adds that the study is likely one of the largest sleep studies ever conducted on Parkinson's. "We have very limited information about manifestations of the disease in their natural environment and [Katabi's] device allows you to get objective, real-world assessments of how people are doing at home. The analogy I like to draw [of current Parkinson's assessments] is a street lamp at night, and what we see from the street lamp is a very small segment … [Katabi's] entirely contactless sensor helps us illuminate the darkness."

This research was performed in collaboration with the University of Rochester, Mayo Clinic, and Massachusetts General Hospital, and is sponsored by the National Institutes of Health, with partial support by the National Science Foundation and the Michael J. Fox Foundation.

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Paper: "Artificial intelligence-enabled detection and assessment of Parkinson's disease using nocturnal breathing signals"

PRESS MENTIONS

The Washington Post

Washington Post reporter Pranshu Verma writes about how Prof. Dina Katabi and her colleagues developed a new AI tool that could be used to help detect early signs of Parkinson's by analyzing a patient's breathing patterns. For diseases like Parkinson's "one of the biggest challenges is that we need to get to [it] very early on, before the damage has mostly happened in the brain," said Katabi. "So being able to detect Parkinson's early is essential."

Full story via The Washington Post →

The Boston Globe

A new tool for diagnosing Parkinson's disease developed by MIT researchers uses an AI system to monitor a person's breathing patterns during sleep, reports Hiawatha Bray for *The Boston Globe*. "The system is capable of detecting the chest movements of a sleeping person, even if they're under a blanket or lying on their side," writes Bray. "It uses software to filter out all other extraneous information, until only the breathing data remains. Using it for just one night provides enough data for a diagnosis."

Full story via The Boston Globe →

Forbes

Forbes contributor Jennifer Kite-Powell spotlights how MIT researchers created a new AI system that analyzes radio waves bouncing off a person while they sleep to monitor breathing patterns and help identify Parkinson's disease. "The device can also measure how bad the disease has become and could be used to track Parkinson's progression over time," writes Kite-Powell.

Full story via Forbes →

WBUR

Boston Globe reporter Hiawatha Bray speaks with *Radio Boston* host Tiziana Dearing about how MIT researchers developed an artificial intelligence model that uses a person's breathing patterns to detect Parkinson's Disease. The researchers "hope to continue doing this for other diseases like Alzheimer's and potentially other neurological diseases," says Bray.

Full story via WBUR →

Fierce Biotech

Researchers at MIT have developed an artificial intelligence sensor that can track the progression of Parkinson's disease in patients based on their breathing while they sleep, reports Conor Hale for *Fierce Biotech*. "The device emits radio waves and captures their reflection to read small changes in its immediate environment," writes Hale. "It works like a radar, but in this case, the device senses the rise and fall of a person's chest."

Full story via Fierce Biotech →

Boston.com

MIT researchers have developed a new artificial intelligence system that uses a person's breathing pattern to help detect Parkinson's sisease, reports Susannah Sudborough for *Boston.com*. "The device emits radio signals, analyzes reflections off the surrounding environment, and monitors the person's breathing patterns without any bodily contact," writes Sudborough.

Full story via Boston.com →

STAT

Researchers at MIT and other institutions have developed an artificial intelligence tool that can analyze changes in nighttime breathing to detect and track the progression of Parkinson's disease, reports Casey Ross for *STAT*. "The AI was able to accurately flag Parkinson's using one night of breathing data collected from a belt worn around the abdomen or from a passive monitoring system that tracks breathing using a low-power radio signal," writes Ross.

Full story via STAT →

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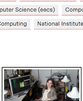
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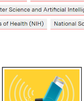
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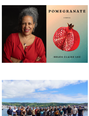
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