Medical Xpress

A.I. tool provides more accurate flu forecasts

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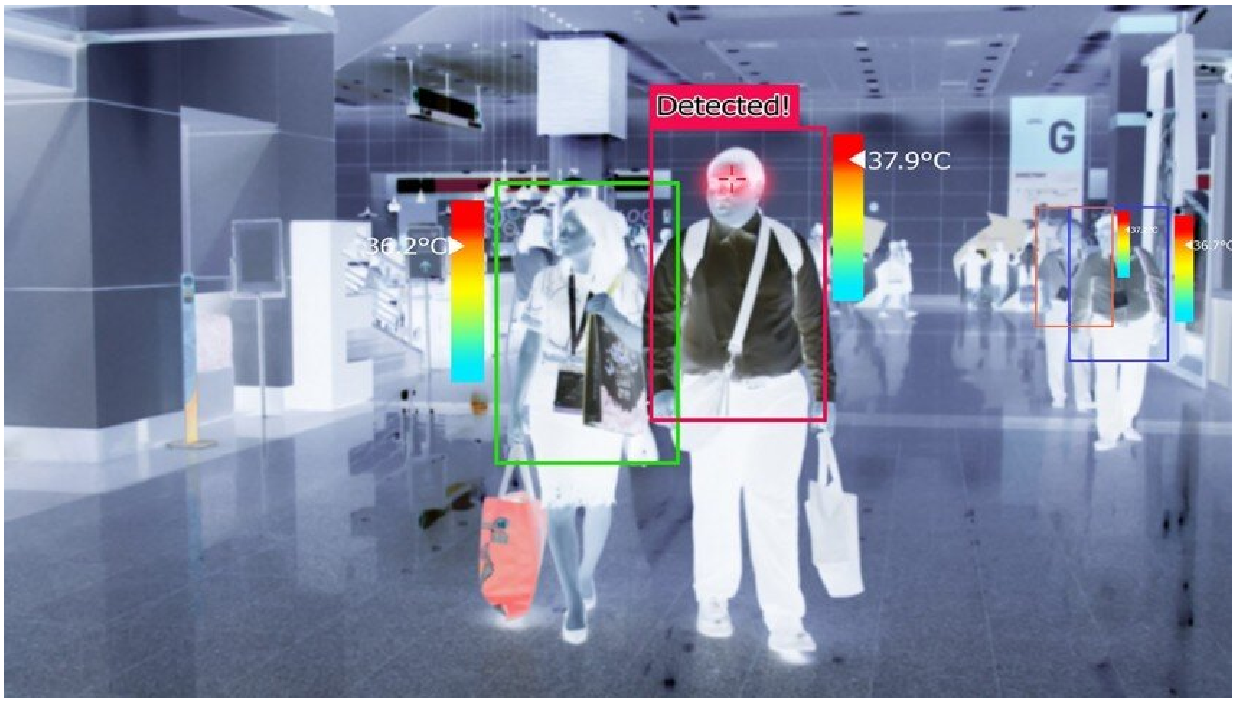

Credit: Stevens Institute of Technology

Predicting influenza outbreaks just got a little easier, thanks to a new A.I.-powered forecasting tool developed by researchers at Stevens Institute of Technology.

By incorporating location data, the A.I. system is able to outperform other state-of-the-art forecasting methods, delivering up to an 11% increase in accuracy and predicting influenza outbreaks up to 15 weeks in advance.

Past forecasting tools have sought to spot patterns by studying the way infection rates change over time but Yue Ning, who led the work at Stevens, and her team used a graph neural network to encode flu infections as interconnected regional clusters. That allows their algorithm to tease out patterns in the way influenza infections flow from one region to another, and also to use patterns spotted in one region to inform its predictions in other locations.

"Capturing the interplay of space and time lets our mechanism identify hidden patterns and predict influenza outbreaks more accurately than ever before," said Ning, an associate professor of computer science. "By enabling better resource allocation and public health planning, this tool will have a big impact on how we cope with influenza outbreaks."

Ning and her team trained their A.I. tool using real-world state and regional data from the U.S. and Japan, then tested its forecasts against historical flu data. Other models can use past data to forecast flu outbreaks a week or two in advance, but incorporating location data allows far more robust predictions over a period of several months. Their work is reported in the Oct. 19—23 Proceedings of the 29th ACM International Conference on Information and Knowledge Management.

"Our model is also extremely transparent—where other A.I. forecasts use 'black box' algorithms, we're able to explain why our system has made specific predictions, and how it thinks outbreaks in different locations are impacting one another," Ning explained.

In the future, similar techniques could also be used to predict waves of COVID-19 infections. Since COVID-19 is a novel virus, there's no historical data with which to train an A.I. algorithm; still, Ning pointed out, vast amounts of location-coded COVID-19 data are now being collected on a daily basis. "That could allow us to train algorithms more quickly as we continue to study the COVID-19 pandemic," Ning said.

Ning is now working to improve her influenza-forecasting algorithm by incorporating new data sources. One key challenge is figuring out how to account for public health interventions such as vaccination education, mask-wearing and social distancing. "It's complicated, because health policies are enacted in response to outbreak severity, but also shape the course of those outbreaks," Ning explained. "We need more research to learn about how health policies and pandemics interact."

Another challenge is identifying which data genuinely predicts flu outbreaks, and which is just noise. Ning's team found that flight traffic patterns don't usefully predict regional flu outbreaks, for instance, but that weather data was more promising. "We're also constrained by the information that's publicly available," Ning said. "Having location-coded data on vaccination rates would be very helpful, but sourcing that information isn't easy."

So far, the A.I. tool hasn't been used in real-world health planning, but Ning said that it's just a matter of time until hospitals and policymakers begin using A.I. algorithms to deliver more robust responses to flu outbreaks. "Our algorithm will keep learning and improving as we collect new data, allowing us to deliver even more accurate long-term predictions," Ning said. "As we work to cope with future pandemics, these technologies will have a big impact."

More information: Songgaojun Deng et al, Cola-GNN: Cross-location Attention based Graph Neural Networks for Long-term ILI Prediction, *Proceedings of the 29th ACM International Conference on Information & Knowledge Management* (2020). DOI: 10.1145/3340531.3411975

Provided by Stevens Institute of Technology