New technology simplifies and enhances analysis and visualization of medical image data

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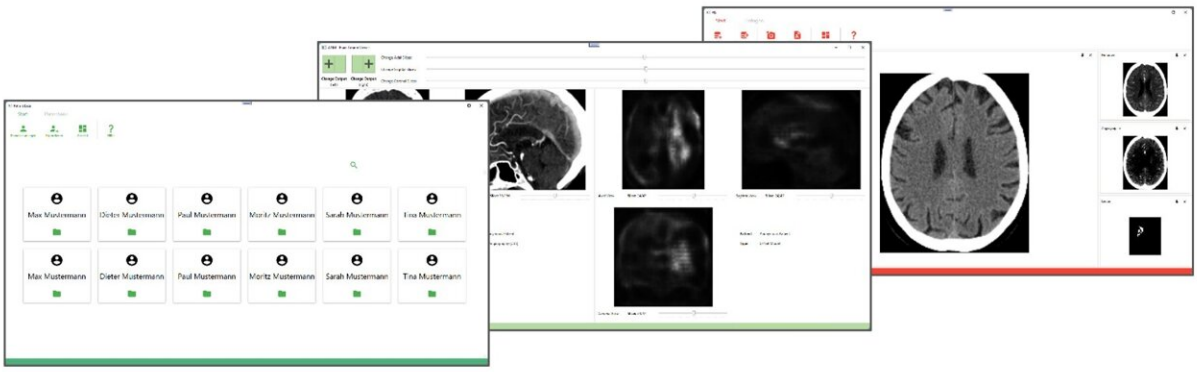

Guardian should make it easy to analyse medical image data in future. Credit: RPTU/Maack, Gillmann

Medical imaging generates a lot of data, for example during computer tomography. This data is important when it comes to personalized medicine. Artificial intelligence methods, such as machine learning, use this data to learn and help tailor diagnoses and therapies to individual needs in the future. However, such technology is still burdened with uncertainties.

A team of researchers from Kaiserslautern and Leipzig is working on a system that automatically analyzes and visualizes medical data, including

their uncertainties. The researchers will be presenting this technology at the medical technology trade fair Medica in Düsseldorf held from 13 to 16 November at the Rhineland-Palatinate research stand (Stand 80, Hall 3).

In the event of a stroke, speed is of essence. Using computer tomography (CT) scans, doctors can quickly determine the position of the blood clot in the brain and what treatment is appropriate. Such imaging procedures play an important role in medicine. They are also used in other areas, for example prior to operations. Magnetic resonance imaging (MRI) scans help surgeons plan an operation before it is performed.

What all these technologies have in common is that they generate a lot of data. "Analyzing and visualizing this data automatically is an important step toward personalized medicine," says Dr. Christina Gillmann, a computer scientist at the University of Leipzig. "This area has gained enormous importance in recent years."

AI processes such as machine learning and neural networks make this possible. These networks learn on the basis of data with which they are trained or "fed." They learn, for example, from CT image data a doctor has previously processed. In this way, technical information, but also medical experience, is incorporated. The rule is that the more data these methods can evaluate, the better the results will be.

In a few years, such technologies have the potential to be used in everyday clinical practice, for example, to enable personalized diagnoses and therapies. However, they are still in the early stages of development. "Each medical case has to be trained individually. The data must be prepared individually in advance, which is very time-consuming," explains Robin Maack from the Computer Graphics and Human Computer Interaction working group at University Kaiserslautern-Landau.

For each medical case, doctors have to "label" the data individually, for example. "This means that if a network is to train to automatically recognize a tumor, hundreds of images with known tumors have to be hand-drawn in so that the neural network has a basis with which to learn," Gillmann explains.

Maack continues, "In addition, there are no standard interfaces with which trained networks can be handled, loaded and used. But also when there are uncertainties in the data layers; be it training data sets or models used; there are no standardized guidelines for how medical professionals should deal with that."

Such uncertainties occur, for example, with lesions. During a stroke, certain areas of the brain are no longer supplied with sufficient oxygen, or not at all, due to the blockage of vessels in the brain. They are no longer able to work efficiently. The core of the lesion is often easy to recognize, but at the edge there is usually no clear demarcation and regions where even doctors cannot agree whether they should be classified as a lesion or not. Ultimately, what is needed here is medical experience on how to deal with these issues.

This is where the focus of Gillmann and Maack's work starts. Their team is currently developing a uniform system for processing and evaluating medical image data and visualizing their uncertainties. The system is called GUARDIAN. The researchers have designed their technology in such a way that it is easy to use. "Clinics can load their trained neural networks and combine them with the processed data provided, for example, in the case of a stroke."

The system evaluates the data and visualizes the results. "This happens automatically, without the need for IT knowledge," Maack explains. "In addition, our method also shows the uncertainties." This means that the doctors can look at them again and, if necessary, make a joint decision

on what is the best treatment in an individual case, for example.

The two computer scientists will be presenting their technology at the fair. The system is freely available as an open-source application.

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