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Digitalisation

Eye check for all - quick and easy thanks to artificial intelligence

Many eye diseases are already easily treatable, if they are detected in time. We're all aware of that, aren't we? But waiting months for an ophthalmologist's appointment seems to be the norm - that is, if you can get to see a specialist at all. The Tübingen-based start-up eye2you wants to improve this situation: it has developed a mobile retinal examination device involving a smartphone and AI. This device can also be used by family doctors, diabetologists and nursing staff and thus help to protect vision in the long term.

Regular preventive care is particularly important as far as one of our most important sensory organs - the eyes - is concerned. For example, the retina with its sensitive, multi-layered nerve tissue can now stay healthy for a long time thanks to regular ophthalmoscopy (fundoscopic examination), in which the back of the eye is illuminated and the reflected image viewed with a magnifying glass. Nevertheless, far too many people still suffer from treatable eye diseases: estimates suggest that in Germany alone, one million people have already become blind or partially blind due to eye diseases, nine million have suffered initial damage, and around 30 million are considered at-risk patients - mainly diabetics and people over 55.[1]



The founding team of eye2you: Dr. Björn Browatzki, Prof. Dr. Christian Wallraven and Dr. Jörn-Philipp Lies (from left to right.)
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The main reason for this is a glaring gap in care provision in the ophthalmology field: the growing need for over 40 million examinations per year is currently met by only around 8,000 specialists in Germany - specialist practices are therefore nowhere near able to cover urgently needed regular preventive care requirements. Yet, timely detection and treatment of impending blindness not only provides patients with a quality of life that you can't put a price on, but also avoids high follow-up costs for the healthcare system - many billions of euros per year, close to 35,000 euros per patient in order to treat preventable vision loss.[2]

Preventive check for the eyes without travelling long distances or waiting for appointments

This is not a sustainable situation, say Dr. Jörn-Philipp Lies, Dr. Björn Browatzki and Prof. Dr. Christian Wallraven, three cognitive systems and artificial intelligence (AI) experts who joined forces in April 2020 to spin out the medical technology start-up eye2you from Tübingen University Hospital. The company's business idea and vision is to develop simpler and faster retinal examinations using smartphones and AI, so that in the future, screening checks won't need to take place exclusively in specialist practices, but also at primary care providers such as family doctors, diabetologists or nursing services.

"It all started when we were working on a research project on how to use AI to detect diseases on images of the retina," Lies says, explaining the brainstorming process. "Over time, we then used the findings to build a prototype that enabled an easy-to-use, safe examination of the back of the eye. We were also thinking about turning the prototype into a mobile solution to help people who can't easily get to an ophthalmologist - whether for practical reasons, because the journey is too long or too difficult, or because they simply can't get an appointment. Mobile solutions already existed, but even these could only be used by specialists. And that's exactly what we didn't want."

System enables full examination without using dilating agents

The Tübingen researchers developed a cost-effective mobile device consisting of a smartphone, a funduscope - an ophthalmoscope used to examine the back of the eye - and an AI system. The system is simple and self-explanatory and performs the analysis in real time in the device while the image is being taken. The result is then displayed on the smartphone. The AI has been trained to detect a wide range of eye diseases, including diabetic retinopathy, glaucoma and macular degeneration. It also provides indications of systemic diseases, for example of the cardiovascular system, diabetes, dementia or COVID-19 consequences. The data is processed offline on the smartphone, so that data protection is guaranteed.



A retinal image taken with the help of a mobile system consisting of a funduscope and a smartphone. Dilating agents for a more complete view of the entire retina are not required. The eye2you AI provides understandable information about the probable disease.
© eye2you

Another major advantage of the eye2you system is that it can take images without using dilating agents for a more complete view of the entire retina. This makes eye examinations much faster and more pleasant. "The examining doctor can see areas marked in colour in the image (see box below on 'explainable artificial intelligence'), which represent potential disease areas. An indication of a probable eye disease is also provided," explains Lies. "Such indications include, for example, 'slight suspicion of glaucoma' or 'very strong suspicion of glaucoma'. Probability information such as '80 probability of glaucoma' can also be given. We are still working with doctors to find out how we can implement this in the most comprehensible way for users." Of course, the system is not supposed to replace ophthalmologists. It is only meant to facilitate their work, as the expert emphasises: "There are so many people with risk factors for retinal diseases, and the trend is rising. It is conceivable for such individuals to have regular eye check-ups with their family doctors on the occasions that they see them. Once there is an initial suspicion of eye disease, the patient can then be referred immediately to an ophthalmologist."

Explainable artificial intelligence (XAI):

In the context of deep learning systems, 'explainable artificial intelligence (XAI)' refers to the fact that people can understand the results obtained by AI. This is in contrast to the concept of the 'black box'.

Affordable equipment for any doctor's practice

With the support of EXIST funding and in cooperation with the University Eye Hospital in Tübingen, the eye2you founders have already begun concrete tests of their so-called retinacorder. "We have just started a first clinical trial at the University Eye Hospital to find out how fast and how easily checks can be performed, and what the quality is. Unfortunately, because of the coronavirus pandemic, the clinical tests have not yet come as far as we would have liked," the scientist says. "But we have used the time to push the technical development even further and to talk to physicians about their needs and requirements. In this context, we are looking to gather even more insights when we carry out usability studies planned for the autumn."

Primary care providers would not have to make any major investments for the equipment which includes a funduscope, costing in the low thousand euro range, plus an extra smartphone and the eye2you software. The developers are working with health insurance companies and doctors' associations to clarify how the system could be implemented in practice. A nationwide application would also be in the interest of the health insurance companies: if we are able to confirm the reliability of the system in clinical studies, the system would not only be in the interest of doctors and insured persons, but would also be economical and innovative.

Platform technology and intelligent tool

Market approval is planned for early 2023. Until then, the researchers have a number of plans: "We naturally want to carry out trials to ensure that doctors who are not ophthalmology specialists will be able to make a reliable diagnosis," says Lies. "And we want to develop the system into a platform technology for different indications. But again, the system is not meant to replace doctors, but instead to be used as an intelligent tool to help them in the diagnosis of eye diseases; for example, by expanding the diagnostic capabilities of primary care providers and giving them more power." The eye2you business idea has already convinced many in the first year since the start-up was established, as demonstrated by numerous awards and prizes, including the start-up competition, Digital Innovations.

The young company is supported not only by the Tübingen University Eye Hospital and various specialists, but also by many other partners such as the Diabetologen Hessen association and CyberValley.

References:

1) Gutenberg Health Study – GHS: Eye diseases - further information at: www.woche-des-sehens.de/infothek/zahlen-und-fakten/augenkrankheiten-zahlen-fuer-deutschland

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Article

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