Website address:
https://www.gesundheitsindustrie-bw.de/en/article/news/fall-prevention-help-balance-enhancing-ar-glasses

Augmented reality for visual orientation

Fall prevention with the help of balance-enhancing AR glasses

As we age, our eyesight deteriorates and we have increasing difficulties with orientation. This can lead to balance problems and fatal falls. A team led by Dr. Lorenz Assländer from the University of Konstanz is currently developing a prototype of augmented reality (AR) glasses that use superimposed patterns to facilitate visual orientation in space, thereby helping to improve balance control and prevent falls.

Falls are a major global public health problem.[1)] They can cause serious injuries and lead to long-term impairments or even death. In particular, advancing age is considered a major risk factor with about a third of people over the age of 65 falling once a year.[2)] Although most of these falls are minor, five to ten percent are severe enough to require medical treatment and significantly increase the burden of subsequent long-term care.

Falls are often triggered by age-related problems with balance control, i.e. the ability to keep the body's centre of gravity stable above a support surface. Decreasing body tension and weaker leg muscles, for example, lead to gait insecurity and increased stumbling. Poorer or slower processing of sensory information by the central nervous system (CNS) is also associated with increased instability.

Three information systems are important for body stability

The CNS essentially relies on three sensory systems to maintain balance: the visual system provides information from our field of vision about the spatial orientation of the head in relation to the environment. The vestibular system with the organs of equilibrium in the inner ear detects our position in relation to gravity and indicates changes in the speed of the head, for example as a result of rotational movements or changes in walking speed. And the muscle, joint and skin receptors in the proprioceptive system provide information about the position of the limbs in relation to each other and about the nature of the ground.

"The CNS has to decide which information is reliable and combine it in such a way that I can keep my balance even when I'm walking on unstable ground or when a train is pulling away in front of me," says Dr. Lorenz Assländer from the Centre for Training and Movement Science (HPRC, Human Performance Research Centre) at the University of Konstanz. This fragile state can only be maintained by constantly comparing actual and target positions and the resulting adjustment of muscle contractions. "Visual information about one's orientation in space, i.e. balance, is strongly influenced by the structure of what we see. A smooth white wall with no contrast makes it difficult for us to orient ourselves. We also find it difficult to stand stably on one leg with our eyes closed," explains the movement scientist, who has spent many years investigating the contribution of the visual system to maintaining balance.

AR glasses provide stationary optical landmarks

With this in mind, he is currently developing a prototype for augmented reality (AR) glasses together with computer science doctoral student Matthias Albrecht and Prof. Dr. Stephan Streuber from the Coburg University of Applied Sciences. The glasses aim to improve visual orientation caused by age-related decline in sensory information processing. Optical clues superimposed on the AR glasses provide wearers with additional information on horizontal and vertical dimensions, making it easier for them to keep their balance. Assländer explains: "Installing the orientation points in such a way that they remain firmly anchored in space even when the head moves is a major technical challenge. We also have to ensure that these stationary patterns are projected in a way that does not distract the wearer in everyday life. After all, we don't want to see crosshairs on other people's noses." The team is therefore focusing on the peripheral field of vision. A small screen is used to make lines or dots appear in the peripheral area of the glasses. They move in the opposite direction when the position of the head changes, making them appear stationary in space.

Dr. Lorenz Assländer (left), along with computer scientists Matthias Albrecht (centre) and Prof. Dr Stephan Streuber (right), is developing AR glasses for fall prevention.
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Successful proof of concept

The researchers have already provided proof of concept and demonstrated that the spontaneous swaying that occurs when the field of vision is obscured can be significantly minimised using AR glasses. The "Augmented Balance" project started in January 2023 and is funded by the Baden-Württemberg government through its "Prototype Funding for Innovative Technologies" programme. The project aims to develop a functional, easy-to-use device and subsequently test it on older people. Before this can happen, however, the technology needs to be further refined and the visual representation improved. This work will be carried out in collaboration with the Fraunhofer Institute for Applied Optics and Precision Engineering IOF in Jena. Until now, the researchers have only been working with freely available off-the-shelf components, but they now need adapted lenses to achieve a good, high-contrast display.

Left: First model of AR glasses with small side screens to test the preferred position of the display. Centre: Expanded model with small screens and semi-reflective lenses. Right: Future vision of AR glasses
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Assländer summarises: "If it is possible to improve the visual orientation of older people in everyday life, there is justified hope that falls can be avoided. And if people feel safer because of the AR glasses, they are very likely to become more mobile again and thus physically stronger." It also makes balance control easier.

The team has already applied for a patent for their innovative idea. Similar but much simpler approaches currently exist only in the area of travel sickness, where glasses create an artificial horizon. At present, the only aids used to prevent falls in old age are walking sticks and rollators. However, these aids only make it easier for users to stay balanced, thereby reducing the risk of falls; they cannot avert equilibrium disorders. AR glasses, however, compensate for underlying sensory deficits and reduce the degree of instability.

Literature:

1) World Health Organization (2021), Fact sheets: Falls. https://www.who.int/news-room/fact-sheets/detail/falls

2) gesund.bund.de (2022): "Stürze bei älteren Menschen: Gesund durch Bewegung". https://gesund.bund.de/stuerze-aeltere-menschen#folgen

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