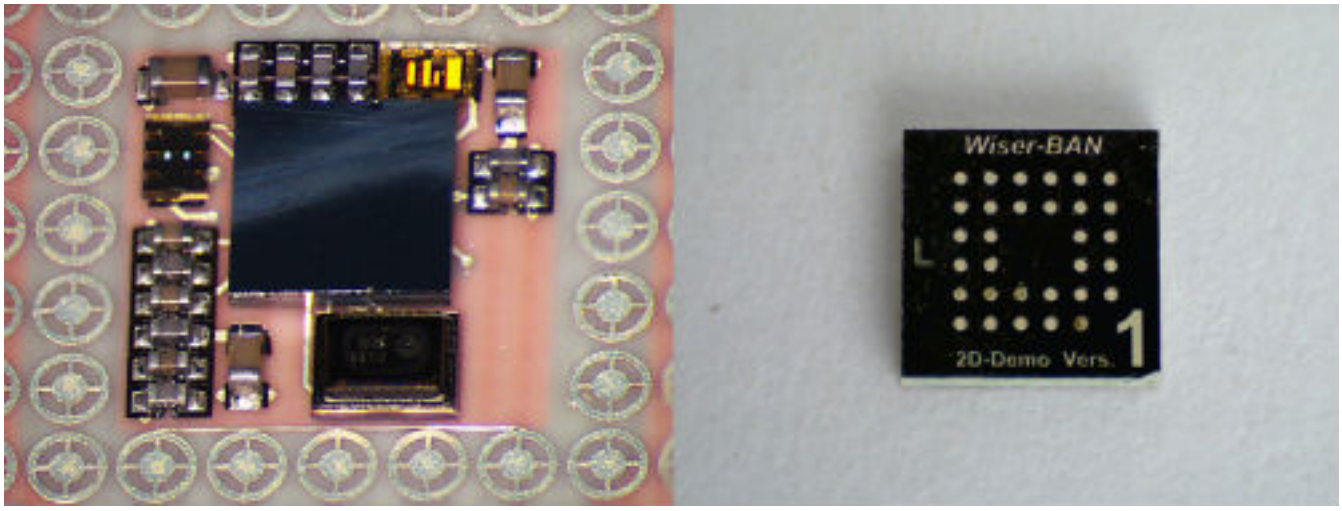
Invisibility Cloak for Hearing Aids and Implants

Fraunhofer



Microsystems are at the heart of portable hearing aids and implants. Now researchers are developing a miniature, low-power wireless microsystem to make these medical aids smaller, more comfortable and more efficient.

People with impaired hearing struggle with things we take for granted, whether it is listening to birds warbling in the garden or chatting with friends and acquaintances. They experience particular problems with hearing at higher frequencies and by following-up conversations. According to the World Health Organization (WHO), hearing loss is one of the six most common illnesses in the industrialized world. In Germany, around one in five of those over the age of 14 have to be treated for hearing difficulties. Often a simple hearing aid can restore the lost frequencies and makes it possible for the patient lead a normal life again.

The device is most often worn behind the ear, although some variants can even be inserted directly into the ear. In the EU WiserBAN project, Fraunhofer researchers are developing a new microsystem designed to make hearing aids so small, so that they can be concealed out of sight within the ear. The technology is also suitable for implants, pacemakers and insulin pumps. This all means that the system uses only a fraction of the energy required by conventional devices, keeping cumbersome battery changes to a minimum. “Ideally, patients should not even be feeling of wearing the hearing aid over long periods of time,” says Dr. Dionysios Manessis from Fraunhofer Institute of Reliability and Microintegration IZM in Berlin.

19 Components in just One Micro Package

With dimensions of just 4.0 x 4.0 x 1.0 mm, the new microsystem is fifty times smaller than the current models for body area network (BAN) applications – electronics applied directly to the body. To achieve this, the project partners first developed especially small components such as innovative miniature antennas, system-on-chip integrated circuitry and high frequency filters. The job of the researchers at Fraunhofer IZM was to find a space-saving concept to accommodate

all the components involved – 19 in all – in a single module.“This is a real challenge as all the components are of varying sizes and thicknesses.

But having exploited various embedding technologies, which lead to advanced system-in-package (SiP) miniaturisation, we have managed to arrange all the components in the smallest possible space – just as in a package,” explains Manessis. As viewed from outside, it is no longer possible to see the individual components. But that is not all, since the Berlin packaging experts have also developed a modular 3D stacking concept that saves extra space. This works by building the components into several smaller modules and then stacking these on top of each other.

Extending the scope of their work, the project partners are also developing special antenna and wireless protocols. These serve to communicate important information such as pulse, blood pressure or glucose levels straight to the supervision Physician’s tablet or smartphone. The resulting WiserBAN wireless system makes obsolete the relay station – an extra device that patients have previously been obliged to wear to extend the communication range. Another advantage is that the wireless protocols developed within the project are based on the reliable IEEE 802.15.4 and 802.15.6 standards. Conventional devices have ordinarily relied on Bluetooth, where there are often issues with interference with other devices.

Project partners are also looking to optimize energy management. Hearing aids worn behind the ear are powered by a 180 mAh battery (milliampere hour), which must be either replaced or recharged approximately every two weeks. Now the aim is to minimize the system’s energy consumption to around one milliwatt (mW), and so to extend battery life to up to 20 weeks. It is hoped that the new technology will act as the springboard for more comfortable and more reliable healthcare products in the future – from longterm electrocardiography to insulin pumps. Furthermore, there is the potential to use the microsystem in implants and pacemakers.