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SonoOne: Intelligent and flexible ultrasonic sensor system based on the modular principle

As part of the Fraunhofer Center for Sensor Intelligence ZSI, the intelligent and flexible ultrasonic sensor system "SonoOne" was developed according to the modular principle. "SonoOne" can serve the rapidly developing ultrasound market, especially in the field of portable systems, with innovative and highly flexible products. On the hardware side, "SonoOne" consists of cost-effective, matchbox-sized modules that can be easily combined and configured into a complete system for a wide variety of applications and, thanks to the modular concept, can be used universally for a wide range of acoustic measurement tasks.

Ultrasound is a flexible, cost-effective, real-time capable and non-invasive technology that has proven itself in a wide range of applications, from medicine to industrial applications. In the field of medical applications, ultrasound is used in varying degrees of complexity. However, even the cheapest systems are still in the range of several thousand euros, which restricts the use in the end user sector (wearables, mHealth, smart health) and addressing mass markets in both the medical and technical context. For example, while the market volume for medical wearables amounted to USD 27.2 billion in 2021, the market for blood flow measurement devices, which are largely based on ultrasound Doppler technology, only reached a volume of USD 0.533 billion in the same year. There is still great market potential for ultrasonic sensor technology in combination with automated signal analysis and classification using artificial intelligence, especially in the low-cost area of wearables.

Ultrasound is also a widely used method in industrial applications, e.g. for measuring flow velocities, distances or fill levels. In contrast to medical applications, technical objects to be examined can be much more varied in size, shape and material. Dedicated application-specific systems with varying degrees of integration are therefore commercially available. These systems are either flexibly designed and therefore complex and expensive, or they are specially developed for a single application and therefore potentially cheap to produce.

With the "SonoOne" sensor system, the Fraunhofer Institute for Biomedical Engineering IBMT has succeeded in developing an intelligent and flexible ultrasound sensor system based on the modular principle in order to be able to serve the rapidly developing ultrasound market, particularly in the field of portable systems, with innovative products in the future. The hardware consists of low-cost, matchbox-sized modules that can be easily combined using plug-in contacts. When configured into a complete system, the modules can be used universally for a wide variety of acoustic measurement tasks in a wide range of applications.

The intelligence of the sensor is based on the analysis and evaluation of the recorded acoustic time signals. This can be done by an external computing unit connected via a standard wifi connection, such as a tablet or smartphone, or by an adapted compact computing unit. In this way, intelligence can be transferred directly to the systems themselves in line with the Edge AI approach. Only the result is transmitted as a measured value. Evaluation in cloud networks is also envisaged so that large volumes of data can be collected via numerous sensors at different locations and stored, analyzed and processed centrally.

In addition, the modular approach means that future innovative technologies (efficient energy storage, new wireless standards, new materials for ultrasonic sensors, manufacturing technologies in electronics and improved analysis algorithms) can be used in a simple way by further developing and replacing individual modules, thus creating the basis for using ultrasound in completely new applications.

The minimum configuration of each “SonoOne” ultrasound system consists of the following three modules:
1. an ultrasound module including an ultrasound transducer for the acquisition of ultrasound time signals over a wide frequency range (kHz-MHz)
2. a communication module for parameterizing and controlling the ultrasonic module and for transferring the ultrasonic data via wifi to a terminal device or server for signal analysis
3. a power supply module to provide the required supply voltages

In addition, firmware is used for measurement sequence control, communication and system setup. The hardware interface to the PC is a commercially available microcontroller board, which implements a wifi interface in addition to a USB interface. It enables the bidirectional exchange of control and status information as well as the real-time transfer of ultrasound data. The ultrasonic system can be parameterized with a user interface and the ultrasonic time signal can be displayed, analysed with various filter and evaluation algorithms and saved to a memory device.

The modular design of the ultrasonic system and the extensive application know-how enable the Fraunhofer ZSI to respond to the diverse specific needs of different com¬panies and industries to obtain a viable product. Talk to us!

Fraunhofer Center for Sensor Intelligence ZSI

The Fraunhofer Center for Sensor Intelligence ZSI is a joint strategic R&D; initiative of the Fraunhofer-Gesellschaft für angewandte Forschung e. V. and the Saarland. As a central contact point, it serves to strengthen research and science in the greater Saarland region for the benefit of society and the economy. The Fraunhofer ZSI develops next-generation sensor systems with AI components for applications in the fields of materials testing, production and bioprocesses as well as healthcare. The focus is on the entire process from data acquisition to analysis and evaluation. For the first time, sensors and sensor systems are being used that make autonomous decisions in real time and on site and thus control processes within a defined framework. The holistic, integrative approach contributes to the development of innovative application systems together with partners from science and industry. In a later phase, these will complement and expand the partners' products.

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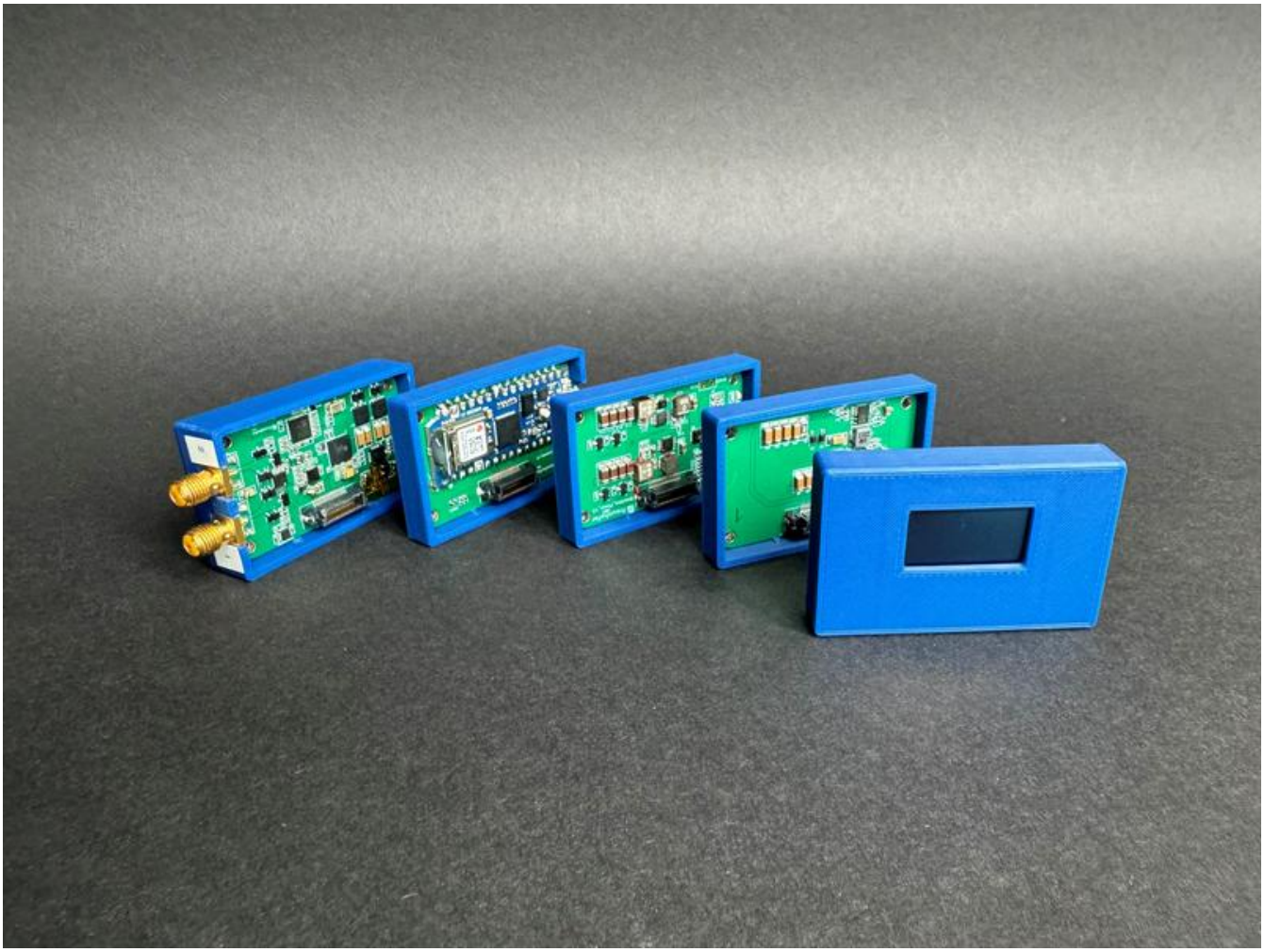
URL zur Pressemitteilung: https://www.ibmt.fraunhofer.de/en/ibmt-core-competences/ibmt-ultrasound.html

URL zur Pressemitteilung: https://www.zsi.fraunhofer.de/en.html



Individual modules of the “SonoOne” ultrasound system.
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