RESEARCH NEWS

Home networking by radar

OmniConnect project: Radar beams for networking and localizing everyday objects

In the OmniConnect project, Fraunhofer researchers are working with other partners on networking objects in indoor areas. They are doing this using radar beams and passive tags that are attached to moving objects, but also to people. This technology effectively detects the positions of the tags and therefore of the objects as well. It can also be used in the care sector, to avert dangers to people who are prone to falling.

For many of us, the term "radar" conjures up scenarios from the aviation or shipping industries. Radar technology is also deployed to search for space debris. This always involves localizing and measuring the velocity of flying objects. In recent years, however, scientists have been seeking to scale up the use of radar beams for applications inside closed rooms. The Fraunhofer Institute for Reliability and Microintegration IZM in Berlin is focusing on a most promising project in this area.

In the OmniConnect project, a radar is used to detect the motion and position of objects inside rooms. The researchers are using what we refer to as a secondary radar. A conventional radar detects objects and their movements, but does not provide any other data. A secondary radar combines radar beams with tags that are attached to objects. These passive tags not only reveal to the system position and movements inside a room, they can transmit information about the object as well.

Energy-efficient, compact, harmless

Thanks to the high frequency in the 60 GHz band, the systems can be developed for a high degree of integration. Each send and receive module is just 25 square centimeters in size. Conflicts with mobile radio networks, Wi-Fi or Bluetooth are impossible. The radiation this technology emits is completely harmless to human beings.

The system developed in OmniConnect is the ideal solution for networking any objects or everyday items with one another or integrating them into a home network. Because the passive tags do not need a separate power supply, there's no inconvenience of having to replace batteries.

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Project in the care sector

Researchers at Fraunhofer IZM have a different scenario in mind — support for people who are prone to falling, suffer from dementia or are in need of care for other reasons. The flexible tags, measuring just 5 cm x 1 cm, can be sewn into fabric without a problem. Staff in a facility equipped with the OmniConnect system, for example, will be able to tell whether a person in need of care is in their home, and can determine their exact whereabouts at any point in time. If the person appears to linger in a certain place for too long, for instance, the carer would be able to check whether all is well. "The position of a tag, meaning the position of the person, can be located to within ten centimeters," explains Christian Tschoban, Project Manager at IZM. As the OmniConnect system detects the height of the tag as well, it also knows if the person is lying on the floor. The system could then raise the alarm, prompting the carers to check whether the person has fallen.

The technical basis

The radar beams are sent and received by a hemispherical element. The ideal position for this element, which looks like a lamp, is on the ceiling in the center of the room. The method for attaching the printed circuit board track and the send/receive module to the polyurethane hemispherical surface is based on special expertise developed by the IZM team in the field of electronic packaging. The first prototypes are in the process of being built. In total, up to nine radar modules are distributed across the "lamp". Arranged this way, the modules offer a very uniform and complete coverage of the entire room.

Fraunhofer IZM has many years of experience in radar technology and has contributed its expertise to the project. Drawing on this knowledge, the research team around Christian Tschoban has now managed to combine a secondary radar with passive tags to create one high-performance system. This in turn forms the technical basis for the OmniConnect unit.

Project partners from Berlin and Oldenburg

The radar technology from Fraunhofer IZM delivers the data, but this still has to be analyzed and visualized, and the system needs to be controlled using software. The Fraunhofer Institute is collaborating with project partners to find a solution. The Institute for Information Technology (OFFIS) in Oldenburg evaluates the data and is responsible for the AI-based system that detects movement and activity. This is especially important for the downstream assistive technology applications, reliably detecting a fall for example. HFC Human-Factors-Consult GmbH from Berlin is programming a user-friendly interface in the form of an app. At the end of the project, the fully developed prototypes will be used to conduct user studies.

Netz-Werker AG, a company that has been developing solutions in the Ambient Assisted Living (AAL) and Smart Home sectors for many years, is another Berlin-based partner. The development of interfaces for the OmniConnect technology is opening the door for the use of intelligent sensors at a new level of complexity.

As Professor Thomas Jürgensohn, Project Coordinator of HFC Human-Factors-Consult GmbH, explains: "In the care sector, OmniConnect offers a cost-effective way of monitoring the movements of people in need of care in their own environment and intervening in emergency situations. But there are many potential applications outside of the care sector too."

Applications in home networking

Home networking is one future-oriented scenario. Here, radar-based technology could help make Internet-of-Things (IoT) applications a reality. Via tags and secondary radars, devices and objects relay their status and their position or exchange data with one another. "Those of us who tend to misplace their key can simply attach a small tag to the key, integrate it into the system and never lose the key again," says Tschoban with a grin. In industrial production, an OmniConnect system can be used for the communication between man and machine. The robot would detect in real time, for example, the exact whereabouts of its human colleague in the workplace.

A first prototype of the system for the care sector is expected to be ready by winter 2021.

Fig. 1 The passive tags can be unobtrusively integrated into everyday objects such as items of clothing. Radar modules on the ceiling detect the position and the movement of the tags.

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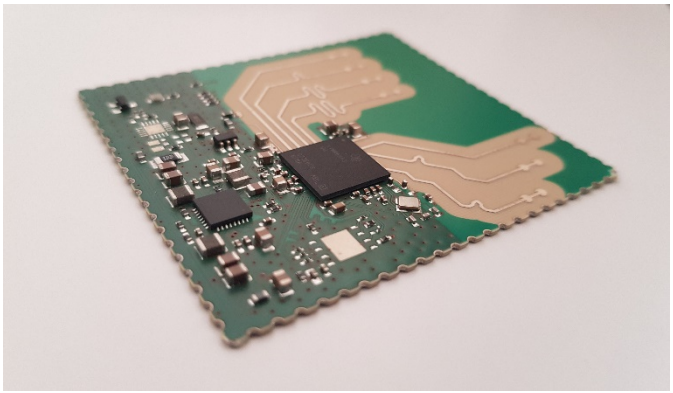

Fig. 2 Up to nine send/receive modules like these are integrated into the lamp structure. In this arrangement, they cover the entire room.

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