

Multiple head radar system



Fraunhofer Institute for Reliability and Microintegration IZM

Window angle

Person 1

Tag

Tag

System Innovations for Radar Technology

3D Object Tracking and Locating Using 60 GHz Radar

Research Project OMNICONNECT

Fraunhofer IZM has developed a miniaturized MIMO radar system, integrated into an LED ceiling lamp, capable of recording and evaluating motion profiles and locating people and objects in a room.

Gapless 360° coverage is achieved by fusing the data from four radar modules. Motion profiles are formed by artificial intelligence algorithms. The radar system can detect more than 30 persons in rooms of up to 150 m² with an angular resolution of 12°. A passive transponder system was developed specifically for location tracking purposes.

LED ceiling light with integrated MIMO radar system

Enabling self-determined living into old age increases the quality of life for elderly people. One prerequisite is that hazards are recognized early and assistance is provided promptly. This can extend to everyday concerns, such as the ability to find misplaced items.

Financial and labor constraints mean that the required support services can only be provided with the help of technology. To aid its adoption, this technology should neither interfere with people's privacy nor be too visible in the room.

In the OMNICONNECT research project, Fraunhofer IZM and its project partners have developed a miniaturized radar system for locating and tracking people and objects indoors.

Realized innovations:

- 3D radar sensor concept with 360° coverage, fusing the data from four radar systems with a detection range of 10m per module at 4GHz bandwidth
- Use of artificial intelligence to analyze movement patterns and spot anomalies
- Development of a concept for precise 3D location tracking by radar using passive transponders

Project partners

- HFC Human-Factors-Consult GmbH, Berlin (Coordinator)
- OFFIS e. V., Oldenburg
- OndoSense GmbH, Freiburg
- Die Netz-Werker AG, Berlin

Project volume

- € 1.98 million
- 81% Funding share

Duration

- 09/2019 - 12/2022

Funding code

- 16SV8310

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The radar modules are based on a 60 GHz transceiver architecture from TI. Four radar modules are required for comprehensive coverage, since the transceivers each cover an angular range (azimuth and elevation) of max. $\pm 45^\circ$.

The data is processed in an FPGA with integrated ARM processor, responsible for controlling the processor and aligning the signal processing. The FPGA transfers the target motion detection and tracking data directly to an AI computing platform.

Each radar module has a 10 m detection range at a bandwidth of 4 GHz. With the Plated Half Holes (PHH) design, each radar module can be integrated into customer boards using standard SMD technologies without requiring prior RF knowledge.

The passive transponders for location detection were designed as frequency-specific radar targets that resonate at a set frequency, turning the transponders into a type of beacon. Each transponder can be identified based on the resonant frequency and located by a »time of response« calculation.

Advantages of the radar system:

- Easy integration of the 3D sensor system into the application environment for a minimum-effort installation
- Ability to detect motion with multiple people tracked simultaneously in the covered area
- Accurate identification of the detected objects with an angular resolution of 12° : More than 30 persons can be tracked separately in the room.
- Location tracking of persons and objects in the room with a resolution of 6 cm in all directions
- Covering rooms up to 150 m²
- Communication interface with common smart home systems

Radar application areas:

- Location and motion tracking of people and objects in domestic and industrial environments
- Navigation tasks, such as landing assistance for unmanned aerial or marine vehicles
- 3D location tracking for autonomous vehicles

Project Status (03/2023):

- A prototype has been developed and tested under laboratory conditions.

The radar system is part of a universal radar platform developed by Fraunhofer IZM for the efficient realization of radar projects. With this ready-to-plug&play radar kit, 24, 60, and 79 GHz applications with ranges from 0.1 to 260 meters and angular resolutions of less than 5° are possible. The frequencies can be combined with single, phase array, and MIMO antenna designs. The boards are mounted via SMD (plated half holes) on conventional printed circuit boards.

You would like to get to know our packaging & frontend solutions for radar modules?

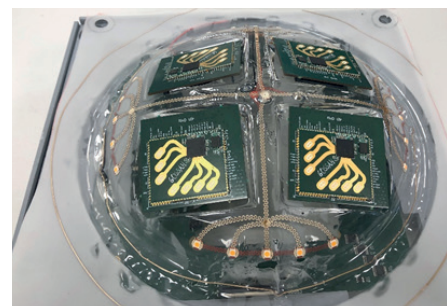
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Fraunhofer IZM, a world leader in the development and reliability assessment of electronic packaging technologies, provides its customers with customized system integration technologies at the wafer, chip, and board level. The research done at Fraunhofer IZM helps make electronics more reliable and provides customers with reliable data about the durability of electronics.



Design of the radar module based on an IWR6843-TI chip



Final assembly with integrated LEDs, four radar modules and interface board

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More information



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