ferrocene

Case Study: Sonair

Delivering safety-certified 3D ultrasonic sensing with Rust and Ferrocene

Executive summary

Sonair is a Norwegian robotics sensor company spun out of SINTEF, one of Europe's leading applied research organizations. Drawing on deep expertise in acoustics and ultrasound, the company is currently developing ADAR™, a compact, software-defined 3D ultrasonic sensor designed to improve safety for autonomous mobile robots and collaborative robots.

To meet industrial requirements for determinism, performance and functional safety, Sonair chose the Rust programming language and partnered with Ferrous Systems to build its ADAR firmware using Ferrocene, the world's first open source, qualified Rust compiler toolchain.

In June 2026, Sonair announced that ADAR One has received functional safety certification, meeting IEC 61496, IEC 61508, and ISO 13849 standards and achieving a SIL 2 rating.

- **Customer**
  Sonair, developer of 3D ultrasonic sensors for autonomous robotics
- **Challenge**
  Deliver deterministic, high-performance firmware for ADAR™, a novel 3D sensing technology, with a clear path to IEC 61508 certification
- **Solution**
  Rust; the Ferrocene open source, qualified Rust compiler toolchain; a certified subset of the Rust core library (core); and technical support from Ferrous Systems
- **Result**
  ADAR firmware, written in Rust and compiled with Ferrocene, supports IEC 61508 SIL 2 safety certification without rewriting core software

The challenge:

Overcoming the Limitations of Traditional Robotic Sensing

Robotic safety systems must navigate unpredictable environments, avoiding humans and obstacles in accordance with strict safety standards. At the same time, these systems must run reliably on embedded hardware, be deterministic, and cost-effective, setting a high technical bar for safe, real-world operation.

Robotic safety systems have traditionally relied on 2D LiDAR sensors. LiDAR, short for light detection and ranging, uses laser beams to measure distances in real time. While proven and certifiable, these systems capture only a single horizontal slice of the environment, leaving blind spots above and below the scan plane and often requiring multiple sensors to approximate full coverage. Camera- and AI-based perception systems can deliver richer 3D data but currently lack a clear path to functional safety certification.

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The solution:

ADAR - Safety-certified 3D Ultrasonic Sensing

ADAR takes a different approach. Using ultrasound instead of light, it delivers true 3D safety coverage (180 degrees by 180 degrees) from a single, compact sensor with no moving parts. This enables reliable detection of people and obstacles at any height, including transparent, reflective or visually complex objects that challenge optical sensors.

In 2025, Sonair moved ADAR from prototype toward commercialization. Its goals were to secure initial design-ins, build a credible customer pipeline and establish a new category of safe 3D sensing that supports reliable human-robot coexistence in public spaces, workplaces and homes.

To translate this sensing capability into a certifiable product, Sonair focused on three requirements: deterministic and explainable algorithms suitable for safety assessment; high performance on embedded hardware; and a clear, achievable path to IEC 61508 certification.

Meeting all three requirements simultaneously posed a major software challenge. Traditional safety-certified stacks rely heavily on C or C++, languages that allow entire classes of memory and concurrency errors that are difficult to eliminate. This makes safety assessments for new products costly and time-consuming.

Building safer, faster firmware with Rust

Sonair's decision to use Rust grew out of its experience with the limitations of C and C++. Rust also offers several advantages: memory safety by design, eliminating broad classes of runtime faults; strong typing and compile-time guarantees that are aligned with functional safety goals; C-like performance with higher-level abstractions; and a modern toolchain that supported rapid prototyping during early development.

"You really get the best of both worlds with Rust," said Espen Albrektsen, Sonair's head of software. "You get the performance and low-level control of C, the abstractions of C++, and fewer legacy issues. The Cargo ecosystem also helped us get up and running quickly as a startup, letting us focus on our core technology while relying on third-party crates for noncore functionality."

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Accelerating safety certification with Ferrocene

When Sonair began its safety certification effort, Rust lacked a safety-qualified compiler, creating the risk that significant portions of the ADAR firmware would need to be rewritten. That changed with Ferrocene, the open source, qualified Rust compiler toolchain, and help from Ferrous Systems.

Ferrocene version 25.11.0 includes a certified subset of the Rust core library that has been assessed by TÜV SÜD for compliance with IEC 61508 SIL 2. This has allowed Sonair to implement most of its ADAR firmware in Rust, including all safety-critical functionality.

The core library provides the low-level building blocks for Rust, particularly in no_std and embedded environments. Sonair views core as the foundation of its software stack: Without a certified base, higher layers will not pass under certification scrutiny. Because certifying the full core library is a multiyear effort, Ferrous Systems began by certifying a subset. The first certified subset was released in December 2025 but did not initially include all the functionality required for ADAR.

"We worked closely with Ferrous Systems in an iterative process to identify required features and test beta releases," said Albrektsen. "At the same time, Ferrous Systems adopted new techniques that significantly accelerated our certification."

In June 2026, Sonair announced that ADAR One has been certified for functional safety. ADAR One was assessed as a human protection sensor according to IEC 61496. It also meets IEC 61508 and ISO 13849. ADAR One is rated SIL 2 (safety integrity level 2). It is a qualified perception component for safety functions requiring PL d (performance level d). It has received EC type-examination certificate from exida.

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Results and outlook

Sonair's collaboration with Ferrous Systems reflects a broader shift in robotics toward modern, safety-focused software. By establishing a practical path to safety-certified Rust, Ferrous Systems and Sonair are lowering the barrier for others to adopt safer systems programming while advancing Sonair's own roadmap.

As autonomous robots become faster, heavier, and more common in human environments, demand for certifiable, high-performance sensing will continue to grow. With ADAR, Rust, and Ferrocene, Sonair has set a new standard for safety in next-gen autonomous robotic systems.