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Efficient Basis for Fusing Camera Data and Ultrasonic Signals

AUTHORS

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Bosch is currently preparing the next generation of its near-range camera system for series production. The system combines ultrasonic sensors and at least four near-range cameras to monitor the vehicle's surroundings. Thanks to intelligent data processing on a single ECU with a multicore microprocessor, the system can detect both static and moving objects, providing a solid basis for safe and reliable automated parking. A hypervisor developed by Etas' partner Lynx Software Technologies acts as the enabler in the background.

SCENARIO

The children are having fun pretending to be drivers. Pedaling their tricycles, they escort their mother's car as it edges towards the garage at walking pace. It stops twice, and each time the kids know exactly what to do. First, they remove a scooter someone has left lying on the ground, and then they tug away their barking dog, Benny, so that the car can continue unimpeded on its automated journey.

Bosch plans to start production of the second generation of its near-range camera system in 2019. One of the features it offers is a driverless parking system called Home Zone Park Assist. To ensure nothing goes wrong when children or animals get in the way, four cameras – each with a resolution of two megapixels – monitor the vehicle's entire surroundings. At the same time, ultrasonic sensors take readings of the area around the vehicle up to a distance of approximately 5 m.

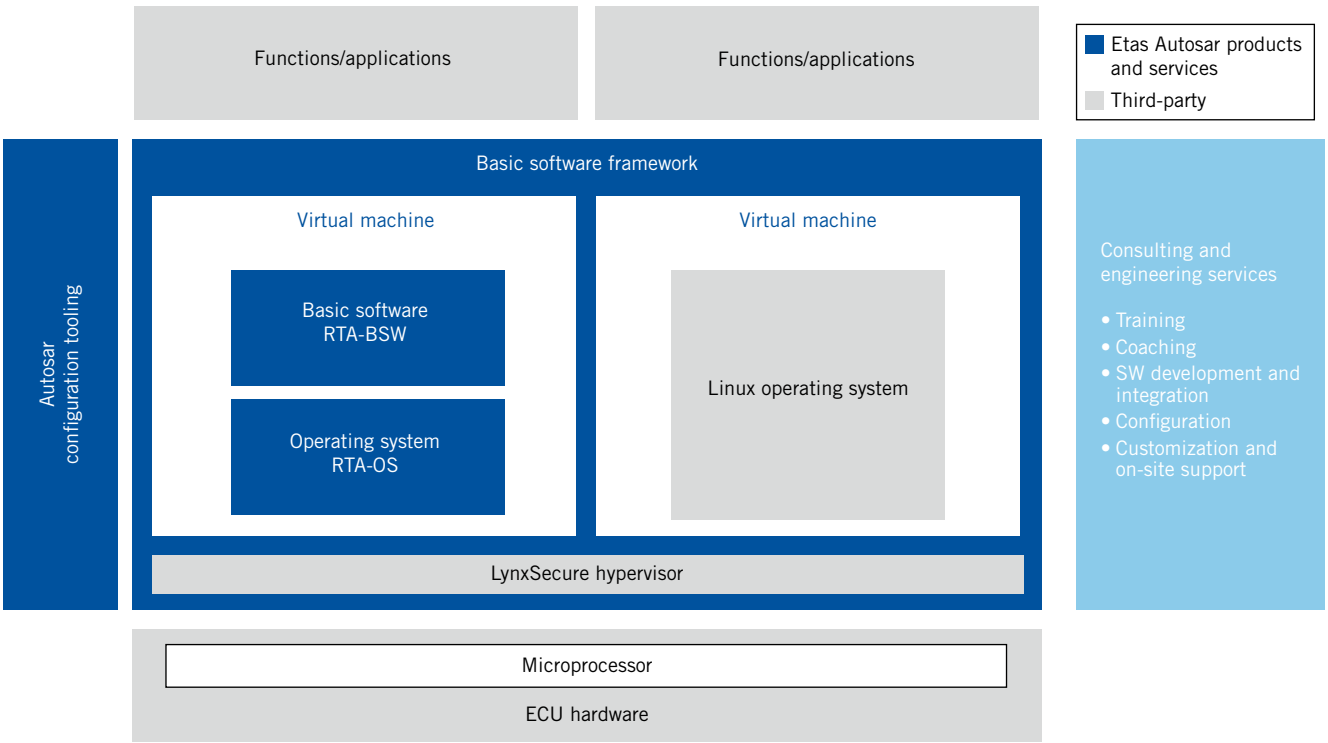

FIGURE 1 Dividing the processor cores into separate virtual machines makes it possible to manage the complexity of the software (© Bosch | Etas)

They detect objects, measure how far they are from the car, and determine whether the objects identified in the video stream could be just shadows or optical illusions. By fusing together this sensor data, the new system can detect both static and moving objects, providing reliable support for both driver assist and driverless technologies.

COMBINED EVALUATION OF ULTRASONIC AND CAMERA DATA

The system combines the camera images into a high-resolution birds-eye view of the vehicle, which it displays in the instrument cluster. That gives drivers full visual control over their parking maneuvers and provides warnings if they are on a collision course. Bosch is setting new benchmarks with both its park assist systems and its advanced display technology. Obviously this kind of system needs to function flawlessly at all times. To meet high safety and security standards while staying within the budget of large-scale production, the developers opted for a completely new system architecture that involves processing video and ultrasonic sensor data in different cores of an ECU with a multicore microprocessor. The processor runs two different operating systems: an Autosar OS (Etas RTA-OS) for the assistance functions and Linux for the display function on one of the four cores. The developers chose the Low Voltage Differential Signaling (LVDS) interface to transfer the giant video files within the required timeframes.

USAGE AND FUNCTIONALITY OF THE HYPERVISOR

Processing data on the different cores of a multicore ECU is cost-efficient and reduces hardware costs. However, it also increases complexity because developers must configure the system to ensure that running processes do not compete with each other for the limited hardware resources available. That means distributing hundreds of functions among the four cores in a way that allows the assistance system to handle safety-critical situations reliably in real time. This is where the enabler of this novel architecture comes into play: The developers have used a hypervisor to partition the ECU into multiple Virtual Machines (VMs). This partitioning forms the basis for running the two operating systems separately, with complete freedom of interference between the processes of each operating system, **FIGURE 1**.

The hypervisor technology was developed by Etas' US partner Lynx Software Technologies. Thanks to Etas, it is now available to the automotive industry. An architecture based on Autosar 4.x already defines basic mechanisms for developing the different software modules on an ECU independently of each other and also provides basic elements for segregating them – even with different Automotive Safety Integrity Levels (ASILs).

But only partitioning guarantees the required safety level of the complex system while enabling cost-efficient implementation on just one ECU. In other words, the hypervisor provides solid foundations for automated parking, not just in financial terms, but also in regard to safety – even in situations where children are at play.