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FUJITSU

How Japanese Artisans Are Transforming the Automobile

Fujitsu Automotive Solutions

shaping tomorrow with you

The car of tomorrow is beginning to take shape.

Where is the automobile headed?
Environmentally friendly electric vehicles (EVs) and hybrid cars are growing in popularity at an ever-accelerating rate.
Increasingly budget-conscious drivers are demanding more economical compact vehicles.
As the population ages, safety becomes more and more important.
Sophisticated gasoline-powered cars are becoming remarkably intelligent, and yet ecological questions remain.
Meanwhile the concept of making imaginative use of the energy stored by eco-cars is taking hold.
Considered from the Japanese perspective, the road to the car of tomorrow is revealing a new form.
It is revealing a car that is considerate of the earth and of people, yet still is a pleasure to drive: a car born of the technologies of Japan, the world's market leader in the EV and hybrid car categories.
Fujitsu Semiconductor Limited will apply its advanced semiconductor technologies and know-how nurtured over many years, and its flexible conceptual capabilities, to contribute to the creation of the smart communities of the future, in which people, cars and entire societies are interconnected.

In harmony with nature

Artisans of Japan – "Kawadoko"
A kawadoko is a platform of box seats extending out from a restaurant dining room to the surface of a river, where guests are cooled by the breeze. The kawadoko of the kifune boat, also referred to as the inner sanctum of Kyoto, features box seats located on the surface of the river itself, enabling guests to enjoy a meal to the accompaniment of the murmur of the river below. Scenes like this, in which a hot summer is painted in cool tones, are common in Japan, a country of great natural beauty. This is the ancient wisdom of Japan, which enables its people to live closely with nature, making masterful use of its bounties.

We believe that ecology means consideration for the global environment.

Semiconductors that respond with innovation to the need for early popularization of EVs and hybrid cars

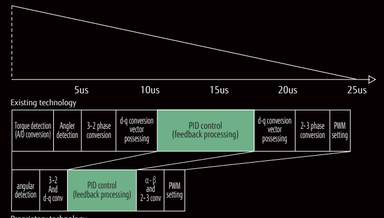
The market for EVs and hybrid cars, which originated in Japan, is expanding rapidly throughout the world. Environmentally responsive stop-start vehicles powered by internal combustion engines are becoming more readily available, accelerating the ecological responsiveness of the automobile. The requirements for these eco-cars include not only improved environmental performance through drive controls and assistance, but also sophisticated innovations for realizing a new energy society by tapping the energy accumulated on board the vehicles.

Drive control ("Active Green") development activities

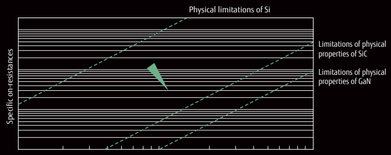
The aim of these activities is higher performance with reduced energy expenditure. The primary difference between cars with internal combustion engines and EVs or hybrid cars resides in their motor and battery controls. Key concerns with respect to motor control include the efficiency with which the motor is controlled, sustaining torque at levels equivalent to those of conventional internal combustion engines, and improving energy economy in the process. We offer products that fuse highly efficient motor control technologies and positional information-detection sensor technologies for motors, based on know-how derived from the sophisticated inverter controls we perfected developing our home air conditioners. Solutions to the issues raised by drive control for EVs and hybrid cars will also be provided by our electronic control unit (ECU) systems–in combination with our high electron-mobility transistor (HEMT) technology that employs the ultra-high-voltage-resistant element gallium nitride (GaN), which is a particular Fujitsu strength.

More efficient DC-DC controls

The transition of technologies from conventional analog controls to digital controls has led to pursuit of greater DC-DC control efficiency. We have developed a number of devices incorporating the requisite functions for DC-DC control. We can also provide the Controller Area Network (CAN). CAN has become the de facto standard for vehicle onboard control system networks.



<Comparison of motor control processing speed with existing technique to FSL's original technique>



<Limitations of Physical Properties of Si / SiC / GaN>

Driving assistance ("Passive Green") development activities

Display systems in eco-cars need game-like sensations and artistic elements that clearly indicate the extent of fuel consumption. Our graphic control devices can realize richly expressive display systems.

Stop-start technologies

Stop-start system-equipped vehicles that use unmodified internal combustion engines require controls for their oil and water pumps. Our advanced technologies can support ECU systems that meet such requirements as high-temperature and pressure resistance, as well as downsizing.

Envisioning a society of smart communities

New ideas for using EV and hybrid car storage batteries are being developed every day. These include using the energy stored in a car's battery in the home when the car is not being driven and, in turn, employing any excess electric power generated in the home to power the car when it is back on the road. These applications require flexible accommodation of electric power through linkage with electrical systems. We are responding to the vehicle-to-home (V2H), vehicle-to-grid (V2G) and home energy management system (HEMS) activities concerned with advanced network and security technologies. We will continue to pursue advances in eco-cars to help bring about the society of smart communities.

Pursuit of functional beauty

Artisans of Japan – "Folding Fan"
The folding fan was created in Japan during the Heian period (794-1185). It is thought that the round fan was introduced to Japan from China, and later modified into a collapsible form that was convenient to carry. When folded the fan appears as a single piece of wood, but when it is opened it spreads out to reveal a charming elegance. The folding fan is indeed a fusion of traditional and functional style. It is an art created by skilled Japanese artisans in pursuit of beauty.

We believe that functional beauty reflects consideration for users.

Richly expressive graphic technologies that help drivers achieve ecological driving

An automobile's functional beauty is more than a matter of stylish external appearance. Functions that give drivers advice on ecological driving and that support safety have been added to the display systems of EVs and hybrid cars, increasing the amount of displayed information. Highly developed capabilities for configuring information and displaying it attractively in a clear manner are essential for the success of these functions.

Realizing richly expressive multi-display systems
The information presented to drivers as they drive continues to increase. It begins with essential driving information displayed by the speedometer and tachometer, fuel gauge, warning lamps and various sensor information intended to keep the driver from falling asleep behind the wheel or from getting too close to the car ahead. It extends to traffic information displayed on car navigation system maps and intelligent transport system (ITS) data. It also includes images from car-mounted cameras and night vision images, and information concerning fuel economy or driving conditions to support ecological driving. Sorting out this constantly increasing information on eco-car display systems and presenting it clearly while minimizing eye movement are critical issues for the auto industry. The graphic technologies we provide effectively sort and present this information. A core graphic LSI capable of high-speed processing of massive amounts of image data, while controlling the information provided by various peripheral components in real time, enables clearer display of information provided by the various functions. This will enable us to realize an advanced, multi-display system that changes content depending on the situation, and clearly transmits the requisite information to the driver.

<A display cluster with an eco-drive assist function>

<CGI Studio>

<An HMI menu>

Step-ahead development in response to evolving 3D navigation systems
Car navigation systems have been transformed from simple road guidance tools to smart tools that provide a wide range of information. The future will bring new demand for intuitive expression capabilities achieved through sophisticated human-machine interfaces (HMI) and a fusion of maps and camera imagery as well as new evolutionary advances. Also, there is the obvious need for improvements in the realistic depiction of full 3D map image displays. Our current graphic LSIs, designed for these next-generation navigation systems, feature industry-leading rendering capabilities and powerful image input-output functions. These LSIs can render maps smoothly in high definition. They can also synthesize external images fed by cameras located on the front, back and left and right sides of the car with 3D graphics to provide displays from freely selectable vantage points. Design tools are also available for developing intuitive, easily understandable, sophisticated HMI to improve navigation system operability. We provide graphic solutions with the hardware and the requisite software.

Keeping watch for safety's sake

Artisans of Japan – "Cresset Light Tower"
A cresset light tower stands quietly on a pier at the mouth of a harbor. "Japanese-style lighthouses" like this one stood watch, providing safety for ships, until the construction of Western-style lighthouses began in the latter years of the Meiji period. Cresset light towers are reported to have numbered over 100 in locations throughout Japan in the late days of the Edo period. The Nozakihama Cresset Light Tower, which remains standing in Kurashiki, Okayama Prefecture, is one such example. This particular tower, built in 1863 (the third year of the Bunkyu era), is an example of the high-lantern timber structure, a rarity in Japan and a precious legacy of Japanese artisans of the past.

We believe that kindness means watching over the surroundings.

Image-processing technologies that provide visual support contribute to safe driving

Drivers are challenged by many blind spots. They try to drive safely by looking around and by using their rearview and side-view mirrors. This is insufficient, however. Today, expectations are rising for the Advanced Driver Assistance System (ADAS)*, which employs multiple cameras mounted on cars as tools to supplement the driver's vision and contribute to safe driving.

World's first "wraparound 3D monitor system"

Systems that synthesize images from multiple cameras to supplement a driver's vision are already in practical use. However, current technologies convert camera images into 2D planar images, which are then pasted together to provide an overhead view. Because they are capable only of imaging road surfaces in the proximate vicinity of the car, the images cannot provide drivers with adequate visual verification. We have developed a "wraparound 3D full monitor system" that synthesizes 3D images of a car's surroundings from images fed by cameras mounted on all four sides of the vehicle, as well as generating images of the car itself by rendering 3D computer graphics. The system can generate images of road surfaces, and can also show a 3D overhead view that includes the car and its surroundings, thereby providing periphery-monitoring images that conventional technologies cannot achieve.


<Conventional technology>


<Wraparound 3D monitor>

Real-time display of conditions in any direction from a freely selected viewpoint

The wraparound 3D monitor system presents 3D images that cover 360 degrees with no blind spots. Additionally it can display images from a freely chosen viewpoint, providing much wider-ranging support for safe driving. Whether the driver is parking, turning left or right, passing on a narrow road or turning onto a highway, the system responds to help him instantly verify safety from a freely selected viewpoint and line of sight.


<Parking lot: Verification possible over a wide range>


<Left turn: Verification of space on the left >

Aspiring to create safer cars (smart safety)

We plan to develop an object-detection technology for the wraparound 3D monitor system. Our aim is to evolve our visual assistance technologies by adding a recognition-support function that prevents oversights by the vision-supplementing function. Cars, moreover, will be made more intelligent through a fusion of information and control system networks (such as image and drive controls) that realize new safe-driving support functions.

**ADAS (Advanced Driver Assistance System): ADAS supports safe driving by notifying the driver of surrounding conditions based on information obtained through various sensors, including cameras and radar.*

Aesthetics of time and space

Artisans of Japan – "Tea Ceremony House"
The tradition of constructing houses exclusively for conducting tea ceremonies dates back to the establishment of the So-an-style tea ceremony house in the Muromachi period (1336 to 1573). Tea ceremony houses in the So-an style are delicately designed on a small site and structured to create space with a sense of tension. They are considered a composite art form representing the time and space of an ongoing tea ceremony. The Rokuso-an (six-window hermitage) shown here was built in the Keian period (1648 to 1652) and relocated to the Tokyo National Museum in the Meiji period. Still in use today, it encourages awareness of the aesthetics and philosophy of austere refinement.

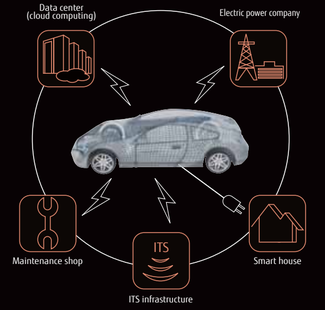
We believe that comfort comprises a pleasing interaction of time and space

Technologies contributing to realization of a society of seamless mobility connecting people with automobiles

Automobiles transport people in a particular time and space. The key word for making this time and space more comfortable is connectivity. The emerging era of "seamless mobility" will assure pleasant conditions for car drivers and passengers by facilitating connections within the car as well as between the car and the ITS infrastructure, the car and the data center, and the car and the home.

Comfort provided by seamless mobility

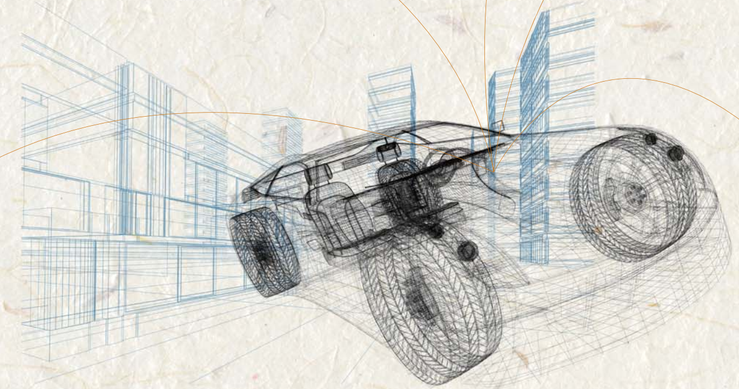
The construction of networks connecting various devices on board cars is accelerating. The control systems and information system network technologies we offer, for example, provide the driver with driving assistance and the passengers with video imagery, enhancing safety and comfort while reducing the burden on the environment. Connecting cars to an external network can make a diverse range of services available. If a car were connected to an ITS infrastructure on the road, for example, it could acquire information such as warnings of danger ahead. It might also become possible to access car control assistance provided by roadside sensors, and perhaps even realize the dream of switching to automatic driving. Connecting a car to a data center, meanwhile, would enable drivers to acquire useful information in real time from the Internet, and permit maintenance shops to diagnose vehicles remotely. Connecting an EV to consumer electronics equipment or a water heater in the home, moreover, would make it possible to employ the storage battery as an electric power storage facility, and facilitate the sharing of energy between the car and the home. This seamless mobility, in the new society that is just around the corner, will allow everyone to move around comfortably with peace of mind.



<Seamless mobility society>

Security technologies supporting comfort

The network environment supporting seamless mobility is becoming increasingly complex, especially with the advent of cloud computing. Construction of robust, reliable structures to support connections has become essential. Sophisticated security technologies, such as encryption or digital signatures, are needed to counter such threats to networks as wiretapping, impersonation and tampering. We are responding to such needs by developing an automotive security accelerator, drawing on our extensive expertise in the field of information technology. This accelerator comprises a chip that can simply be added to an existing automotive platform without burdening the ECU, thereby achieving reliable security even for communication channels and Internet connections. Such innovations in semiconductors are supporting the network environment that is enhancing comfort and security in the automobile.

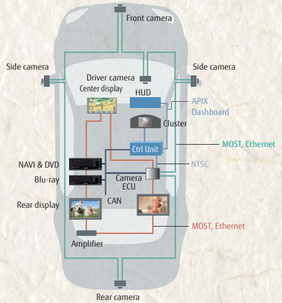


We will continue to provide a variety of advanced technologies leading to the cars of the future.

Fujitsu Semiconductor exhibits leadership through constant evolution in cutting-edge semiconductors, while building on our foundation of providing automotive devices with advanced technical capabilities. We consistently achieve ever greater quality, ever more sophisticated functionality, and ever higher levels of efficiency–as new challenges keep arising as the automobile evolves.

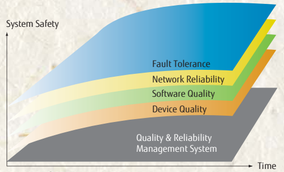
Network technologies

The critical component in the car of the future is network technologies. These go beyond simply linking devices inside the car to creating close connections with external network environments, thus supporting the car's evolution into a mobile entity that is friendly to both people and the earth. We will make a full and varied complement of network technologies available, beginning with CAN, the de facto standard for automotive networks, LIN or FlexRay, P2P and APIX with interactivity, as well as MOST for audio applications and Ethernet. By fusing control system networks with information system networks and sophisticated security technologies, we will contribute to the development of the next-generation EV that will flourish in the coming society of smart communities.



Motor control and functional safety

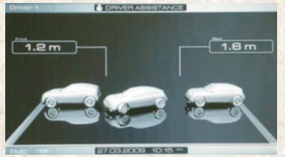
Motor control is the key to tomorrow's automobiles. Our motor control technology not only entails inverter controls, it also contributes to various ByWire controls. While assuring functional safety is essential in the development environment, we will also pursue an ideal image of motor system solutions, maintaining close links with the motor control development environment.



Graphic technologies

As the world's population ages, driver-support functions are becoming more important. Image-processing technologies that convey necessary information in a clear manner will play an important role in that support. We will provide people-friendly HMI technologies and fuse them with various images provided by cameras and other sources, centered on advanced graphic technologies with their long history in instrument panels and car navigation systems.

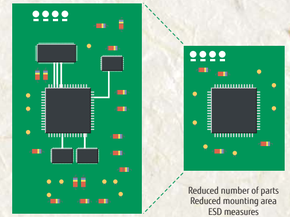
<Periphery monitoring>



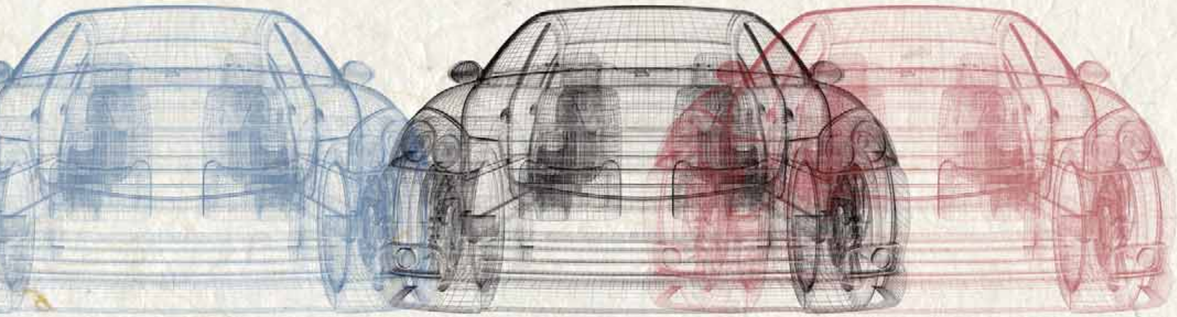
<Parking assistance>

Mixed mounting of Flash and analog

Digital/analog integrated technologies employ high voltage analog technologies, save space and consume less power, while improving temperature resistance–all of which represent improvements that contribute to the environmental measures pursued by automotive ECU systems.



Reduced number of parts
Reduced mounting area
ESD measures

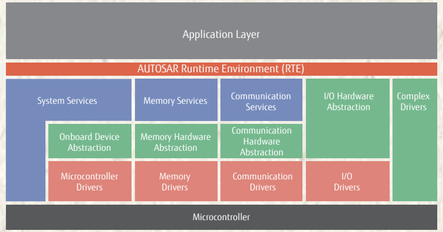


We can provide total environments to accelerate our customers' development.

Fujitsu Semiconductor not only provides automotive devices, we also offer complete automotive solutions based on those devices. As a preferred partner of our customers, we supply total environments for quickly and easily developing complex and large-scale automotive software.

AUTOSAR

The multi-functional capabilities and sophisticated functions of today's cars require large-scale, complex software. Tiny mistakes hidden in the shadows of this software are difficult to detect, but can threaten the safety of the automobile. The concept underlying AUTOSAR, which is implemented according to global standards, is to increase the reusability of software through sharing software components to break through such restrictions. The products we launch into the market comply with the AUTOSAR concept.



ISS*-less technology

As vehicle controls become increasingly complex, more quality, sophisticated software products are needed. We help shorten debugging time by providing a development environment for the ISS-less method. ISS-less simulates only the microcomputer functions necessary for the operation of vehicle-control software, thus supporting development of software for the car's ECU without the use of hardware.

**Instruction Set Simulator*

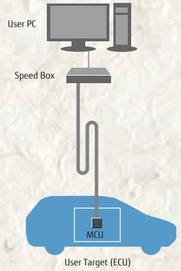
CGI Studio

This software development platform for 3D HMI can be used by designers to create user interfaces, and by engineers to create applications in a smooth, collaborative process. Development of graphical interfaces and applications can be done on a personal computer provided with an environment for preliminary verifications that can be used even when no hardware is immediately available. The software helps to shorten development time and to reduce costs.

<example of monitor>

SPEED-BOX (OCDE)

This on-chip debugging-type emulator can be connected with a CPU on the target with just a single line. On-chip debugging can be performed in real time on compact devices or equipment installed in tight spaces by connecting the CPU employed in an actual ECU system, via a single special interface line for debugging, from a distance of up to 10 meters. This interface complies with the Japan Automotive Software Platform Architecture (JasPar) industry standard.



Joining customers in global success

Fujitsu Semiconductor is expanding its global network to meet the needs of customers engaged in dynamic corporate activities on a global scale. From individual locations in Europe, where the trends originated, to the huge U.S. market and on to Asia, where significant growth is occurring, our customers are coordinating their efforts to provide timely automotive solutions.

Domestic Network

Headquarters / Development and Design
Shin-Yokohama / Akiruno Technology Center

Sales Office
Shin-Yokohama (HQ) / Nagoya / Mikawa / Osaka / Fukuoka

Manufacturing Plant
Iwate Plant / Aizuwakamatsu Plant / Mie Plant

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