Driver Assistance Systems Pose FPGA Opportunities

Invisible intelligence is coming soon to a car near you.

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One of the most important issues in the automotive industry over the last 10 years has been the rapid adoption of safety systems. Features such as airbags, antilock braking and tire pressure monitoring have become increasingly common on many new vehicles, as drivers have become aware of their benefits and, in some cases, lawmakers have made installation mandatory to increase road safety and reduce fatalities. The emphasis on driver safety shows no signs of abating, and over the next decade, drivers will become increasingly familiar with a new generation of systems commonly referred to as "driver assistance."

Driver assistance systems differ subtly from conventional safety systems. Their primary purpose is to detect conditions that could potentially lead to an accident, and to either warn the driver accordingly or to take preemptive action. A conventional safety system such as the airbag, by contrast, serves as the "last line of defense" and is triggered only in the event of a crash.

Perhaps the best introduction to the functions and utility of driver assistance systems is to look at everyday driving experiences and see how these devices can help in certain challenging conditions.

Lane Departure Warning

Let's start with the commute home after an all-day meeting. Chances are you are not at your most alert and your thoughts are probably not all focused on the road ahead—so much so that while changing the play list on your iPod, you begin to drift out of your lane and move dangerously close to the adjacent vehicle. Left unchecked, this could be one commute you never finish.

For assistance in such a situation, lane departure warning systems use sensors mounted in the front of the car to "see" the markings in the road ahead, combined with complex computers that do the high-speed math to detect the car's position on the highway. Stay comfortably within the confines of your lane and all is well; stray too far to the left or right without using the indicators and the system will detect your lapse and automatically provide an audible warning.

While lane departure warning may sound somewhat extravagant, there actually is a need. According to statistics from the National Highway Traffic Safety Administration, around 130,000 people are injured each year in the United States alone in accidents related to lane changing. No wonder, then, that automakers have already taken note of the safety benefits.

As is often the case with new technology, a number of European carmakers are slightly ahead of the pack, offering lane departure warning on vehicles such as the Audi Q7 SUV and BMW 5-Series. In the United States, GM has already shipped Buicks and Cadillacs with such systems, and in Japan, both Nissan and Toyota have cars in production with lane departure warning.

Blind Spots and Night Vision

Take another scenario: Perhaps you've been out on the highway for an hour with the stereo blasting and the cruise control engaged. You go to overtake a truck, forget to check to see if it is safe to pull out and miss the compact in your mirror's blind spot that was passing you at the same time.

This is an accident that wouldn't happen in a car with blind-spot monitoring, a technology that uses camera modules or even short-range radar to constantly peruse the blind spots to the left and right of your vehicle. You pull out to pass and the system will know there's a vehicle in your blind spot, and warn you of the danger accordingly.

Another driver assistance technology is designed to help out in the dark. Night vision assist is, as the name suggests, a system used at night to see objects ahead of the vehicle that are farther away than the illumination range of conventional front headlamps. Night vision assist systems use cameras with either IR illumination or thermal imaging to project an enhanced image of the road ahead onto the screen in the center console.

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Intelligent Cruise Control

Perhaps the most obviously useful example of driver assistance is intelligent cruise control. One of the greatest drawbacks of conventional cruise control is that this is a "set-and-forget" system and will, quite literally, drive the car into a wall if the driver is distracted or not paying attention to the road ahead. In contrast, intelligent cruise control typically uses radar to provide a real-time measurement of the distance to the object directly ahead of the vehicle, controlling the throttle and brakes to adjust the speed accordingly.

Taking safety another step further, the most advanced systems feature predictive collision warning, which combines functions of intelligent cruise control with the airbag system. In the event that a crash is deemed imminent, the system takes action prior to the impact by firing the seatbelt pretensioners to move the driver and front-seat passenger into an optimum safety position.

Brisk Market Foreseen

Table 1 presents the worldwide market for driver assistance systems in terms of system shipments.

As can be seen, the intense interest in driver assistance systems is well justified when looking ahead to the forecast for future years. Shipments of lane departure warning systems, for example, are set to rise to almost 11.5 million units in 2012, up from less than 1 million in 2007. Further, intelligent cruise control is expected to enjoy rapid adoption over the next five years, as this feature makes the transition from luxury cars to high-volume upper- and midrange models. Overall, Semicast estimates shipments of driver assistance systems to pass 23 million in 2012, compared with about 3 million last year.

The growth in unit shipments means a concomitant rise in semiconductor content. Table 2 presents the worldwide market for semiconductors in driver assistance systems in terms of revenue.

Semicast forecasts that semiconductor revenue in driver assistance systems will grow at a CAGR approaching 33 percent from 2007 to 2012, from $229 million to $926 million. By comparison, the total automotive semiconductor market, which totaled $20 billion in 2007, is forecast to grow at around 5.5 percent a year, to $27

	2007	2008	2009	2010	2011	2012	CAGR
Land Departure Warning	0.9	2.5	4.5	6.9	9.9	11.5	65.9%
Blind Spot Monitoring	0.3	0.6	1.1	1.6	2.6	3.6	60.9%
Night Vision Assist	0.8	1.3	1.4	1.9	1.9	2.4	24.4%
Intelligent Cruise Control	1.1	1.7	2.6	3.6	4.9	6.1	41.8%
Total	**3.1**	**6.1**	**9.6**	**14.0**	**19.3**	**23.6**	**49.9%**

Table 1 – Driver Assistance System Shipments (MU)

	2007	2008	2009	2010	2011	2012	CAGR
MCU/MPU/DSP	54	94	136	182	232	260	36.8%
ASIC/ASSP/Other Logic	12	28	46	63	82	89	49.8%
FPGA	55	107	133	155	173	182	26.8%
Optoelectronics	93	144	185	240	284	318	28.0%
Other Semiconductors	15	28	39	54	67	77	38.2%
Total	**229**	**400**	**540**	**693**	**838**	**926**	**32.2%**

Table 2 – Worldwide Market for Semiconductors in Driver Assistance Systems ($M)

billion by 2012. Clearly, driver assistance systems will be one of the highest-growth areas by far for automotive semiconductors over the next five years.

The highest revenue growth for semiconductors in driver assistance systems is forecast for the optoelectronics category, where CCD and CMOS image sensors and millimeter-wave radar modules are likely to be the main drivers. The next-highest revenue growth is forecast for MCUs, MPUs and DSPs, where growth is mostly limited to 32-bit devices for high-end control.

Opportunity for FPGAs

Historically, whenever automotive OEMs needed a highly customized logic product to meet the demands of a specific application, they would automatically turn to an ASIC vendor to help them develop either a gate array or standard-cell-based product to meet their exact requirements. As ASIC development costs have risen and design times have extended over the last five years, automotive OEMs have been forced to consider other solutions.

In some cases, semiconductor vendors have been successful in developing off-the-shelf ASSPs that meet many of the generic needs in systems for, say, entertainment or navigation. In driver assistance systems, however, design changes are so frequent that an ASIC is rarely a suitable choice. Moreover, OEMs typically each have such complex and individual requirements that it is often not possible for semiconductor companies to develop suitable off-the shelf ASSPs that meet the cost, power or reliability goals of the application.

To meet their needs in terms of cost, flexibility and time-to-market, automotive OEMs developing driver assistance systems are increasingly looking to FPGAs. While FPGAs have been used in the development and prototype stages of many automotive systems for the last 10 years, the design has typically involved an ASIC conversion prior to full-scale production, to minimize cost in high volume. However, as FPGA unit costs continue to come down, the technology becomes financially viable in designs up to much higher volume. Add in the unrivaled flexibility to make changes late into the design process and the excellent performance of FPGAs when configured to do the high-speed computational analysis required by many driver assistance systems, and you have a winning combination.

As the data in Table 2 shows, Semicast does not forecast an end of ASICs and ASSPs in driver assistance systems anytime soon. ASIC/ASSP technology will continue to appeal over the long term, especially once the design requirements of the systems begin to stabilize.

However, Semicast forecasts substantial revenue growth for FPGAs in driver assistance systems over the next five years, from $55 million in 2007 to $182 million in 2012, a growth rate exceeding 25 percent. The FPGA market in automotive applications is now accelerating at full throttle, with driver assistance the leader of the pack.

To the average consumer, driver assistance systems may sound like unnecessary and expensive luxuries. Of course, much the same was said about airbags and antilock brakes when they were introduced, but their ability to reduce fatalities and injuries and improve road safety did not go unnoticed by lawmakers for long.

The road forward for driver assistance systems looks assured, with vehicle makers increasingly using the technology to demonstrate their commitment to road safety. While these systems will not save lives in quite the same way that airbags and ABS do, they sure can help in a crisis. And as with all the best technology, you don't even notice they are there until you need them—at which point, you're grateful you had them.

About the Author

Colin Barnden is principal analyst for Semicast's Automotive Electronics & Entertainment Systems Service. He has worked as a market analyst for 14 years and has researched and reported on the automotive industry since 1999. He holds a BS in electronic engineering from Aston University, England.