SAFETY COCOON

Bringing intelligent vision to automotive

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To achieve the safety-focused ideals offered by assisted and autonomous driving, vehicle manufacturers and Tier 1 suppliers need to put together a suite of sensors, computing resources, and other components that can work together to provide a “Safety Cocoon” around the driver and passengers in a vehicle.

INTRODUCTION
Cars equipped with autonomous and assisted driving capabilities are one of the hottest topics in the tech industry. They’ve also captured the imagination of many consumers, who are eager to purchase vehicles with features such as automatic braking, lane departure warnings, and even some basic automatic driving, all of which can avoid accidents, reduce fatalities, and make our driving experiences safer and more enjoyable.

In order to achieve this, automakers and Tier 1 suppliers need to piece together intelligent systems made up of numerous sensors and computing elements that can provide these capabilities. Key among those components are cameras equipped with high-quality image sensors that are placed at various points around the vehicle to support a 360° view of the car’s surroundings. These image sensors provide the digital “eyes” that allow the car’s onboard computing system to “see” the environment around the car and react accordingly. To help achieve the highest safety levels, these cameras need not only to meet, but often even to exceed the visual acuity of the human eye.

“To be as effective and as safe as possible, assisted and autonomous vehicles need an array of highly tuned camera sensors to provide the ‘digital eyes’ these cars need to function.”

The quality of these sensors, their range of capabilities, and their specific suitability to numerous challenging real-world driving situations are critical to help deliver the best possible inputs into the car’s assisted driving algorithms. The quality of the data that feeds from these image sensors is a key factor in ensuring the best possible outcomes from that data. Working along with the car’s integrated intelligence, a collection of the appropriate image sensors can enable a “Safety Cocoon” that protects the car’s driver and other occupants from harm.

AUTOMOTIVE REQUIREMENTS
Technical requirements of automotive-grade image sensors are high and difficult to achieve because of the demanding environments in which they are placed. Enormous ranges in...
temperature and ambient light levels can wreak havoc on sensors that are not properly equipped to handle these types of conditions. Proper functioning of assisted and autonomous driving features demands consistent quality across a wide range of environments. In fact, to ensure the highest levels of safety, it’s actually more important that sensors function well at temperature and light extremes, because those are often the situations where better than human level vision is critical to help avoid potential accidents.

The resolution of automotive camera sensors is extremely important, with many applications now demanding 4K (3,840 x 1,920) resolution in the image sensor in order to be able to do things correctly, such as identify and read street signs from a long distance away. Similarly, the dynamic range of the sensor, or the number of light and color levels that can accurately (and consistently) be captured, is also critical for automotive applications. For situations such as coming out of a dark tunnel into bright sunlight or being able to see pedestrians near a car at night under very low (or even no) light conditions, the dynamic range of the image sensors must be extremely broad.

One of the primary goals of assisted and autonomous driving features is to increase the safety beyond what humans alone can offer, and that means the image sensors have to be able to “see better than the human eye” to avoid potential problems in these types of situations. So, for example, while the human eye typically offers 104db of visual dynamic range, effective automotive sensors should go even higher. Similarly, these sensors need to have extremely sensitive low-light operation, to give night vision-type functionality to automobiles that incorporate them. Operating with a 14db signal-to-noise ratio in conjunction with a wider signal-to-noise ratio distribution, for example, is essential for night-time driving safety.

These high dynamic range, or HDR, functions are conceptually similar to the HDR features now found in today’s best digital cameras, smartphone cameras, TVs, and other consumer devices. In the same way that HDR features in consumer devices have enabled significantly higher image quality in those applications—visibly more noticeable than enhancements in pixel resolution in many cases—so too does HDR support positively impact the image quality of sensors that offer it.

On top of this, cars often find themselves in extremely different environments, from icy, snowy, below zero weather, to 100°+ extreme heat, to rainstorms in more moderate temperatures. Regardless of the environments, carmakers need to deliver (and consumers expect) assisted and autonomous driving features that work equally well, which means all the elements in the computer-assisted driving system need to have that degree of flexibility. This can be a particular challenge for image sensors, because the quality and accuracy of their output can often be impacted by these temperature swings. Vendors looking to source image sensors need to pay particularly close attention to how consistently the cameras perform across wide swings in temperature, humidity, and other real-world weather situations.

WORKING TOGETHER

As mentioned earlier, different combinations of sensors are necessary to deliver a complete view around the car so it’s critical to have a full suite of different cameras for different parts of the vehicle. The requirements for forward-facing cameras are different than ones facing the side or looking backwards from the rear of the vehicle, so it’s important to have a range of different options to choose from when putting together assisted and autonomous driving systems.

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For example, to accurately cover the front of the car, a system needs both a camera with a wider field-of-view and shorter range, along with another that has a narrower field-of-view but much longer range. Image sensors on the side and back of the car have different field-of-view and depth requirements, with longer distances required on the side and on a centrally located rear camera.

In addition to different types of cameras, many automakers are supplementing their assisted and autonomous driving systems with other types of sensors, such as lidar and radar. These types of sensors can provide data behind objects, in visually challenging environments (such as torrential downpours), and other situations where cameras can’t
provide the entire picture, or where supplemental information about surrounding objects can have an important influence on automated driving decisions.

Vendors working to piece together complete systems need to consider the types of business and technical relationships that image sensor suppliers have with other makers of assisted and automated driving components. This includes companies who make radar and lidar sensors, as well as those providing the computing hardware and software that today’s ADAS-enabled and tomorrow’s fully autonomous cars will have. Tech companies like Nvidia and Mobileye, as well as Tier 1 automotive suppliers like Bosch and Denso all play critical roles here, so it’s important to ensure that image sensor suppliers have strong relationships with these organizations.

One image sensor supplier that does have these relationships is Sony. Few, if any, companies in the world can match the overall imaging legacy of Sony, and they’ve now brought those capabilities to the automotive market. They bring with them not only the ability to meet the critical technical requirements for automotive applications, but a long history of innovation in the imaging world and an excellent reputation for overall video capture quality and fidelity. Plus, their image sensor business is a large, established supplier in many other industries, achieving over 54% share of the worldwide smartphone camera imager market, 49% of revenues in security cameras, and 67% in DSLRs, with a total of over 9 billion units shipped since its inception.

LOOKING AHEAD
As cars become increasingly intelligent, it’s essential to give them extremely high-quality image input so that they can assist human beings to drive more safely and help save lives. Like many other systems, assisted and autonomous driving algorithms and the features they enable have to get the best possible inputs if they’re going to enable a “Safety Cocoon” that can make the driving experience truly safer. Lower quality or less consistent images are simply unacceptable for these critical systems. Tier 1 suppliers and OEMs need to consider their imaging sensor suppliers very carefully if they want to deliver the best (and safest) possible driving experience for their customers.

Plus, it’s important to remember that a company like Sony has both a long history of imaging innovation and a long-term plan for innovations in the future. Not only do they leverage their advanced imaging capabilities, such as stacked sensors for the smartphone, security camera, and automotive markets, they’ve started using them in other cutting-edge applications like consumer robotics, with their latest generation ‘aibo’ robotic dog, as well as advanced computer vision applications for industrial manufacturing.

Sony is also thinking about other problems in the automotive industry that have proved to be tough to solve. One example is resolving ongoing issues with in-car speech recognition accuracy, mostly due to the dynamic noise environments experienced in most cars. Sony is looking at alternative ways to use AI and image sensors that visually read a person’s lips to improve the issue of conventional audio-based speech recognition.

Companies looking to build the cars of the future need to consider working with suppliers who also have a strong vision of the future so that, together, they can enable the type of assisted and autonomous driving features that will make our roads safer for all of us.