

White Paper

ADAS Safety Focus: Around View Systems

Introduction

Automobile safety has driven several key innovations over the years from anti-lock brakes to airbags. German automakers have been first to leverage many of the most advanced technologies to improve driver safety and the overall driving experience. For example, German vehicles were the first to offer active lane keeping assist, which introduces a vibration to the steering wheel when the driver veers from his lane. Then came side assist radar to help drivers safely change lanes. It alerts the driver to a vehicle in their lane-changing blind spot with a light that comes on in the exterior side mirror. This was followed by stop-and-go and brake assist, which reduces the risk of rear-end collisions by quickly asserting the brakes before an impending crash.

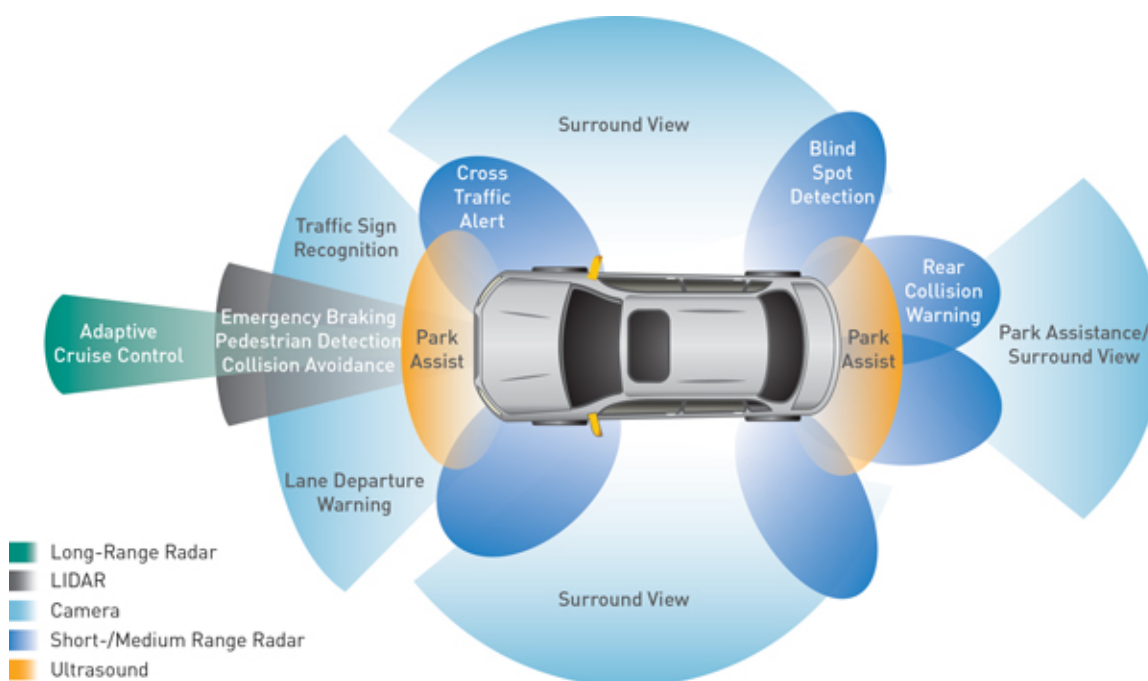


Figure 1. Advanced Driver Assistance Systems (ADAS) encompass a growing list of safety features

These features have become more sophisticated over time and more pervasive, particularly with the introduction of safety cameras in the vehicle to eliminate the driver's blind spot.

Back-Up Camera Becomes Baseline

The Insurance Institute of Highway Safety in the United States recently released a study that showed the chances of dying in a crash in a late-model vehicle have fallen by more than a third in the short span of three years. In fact, advances in safety have improved fatality rates by such a high margin, that automobiles being sold today offer meaningfully better safety statistics than even those introduced only five years ago. This is

creating a virtuous cycle for automakers, giving drivers a reason to purchase a new vehicle sooner rather than later.

There are many reasons for the improved safety, from mechanical and structural improvements to increased safety-related legislation. But one of the most interesting and fastest growing safety applications is Advanced Driver Assistance Systems (ADAS). These systems use a combination of sensors, cameras and displays to provide greater driver visibility, and react to dangerous situations when a driver doesn't.

A blind spot is defined as the area where a driver's view is obstructed. The back-up camera, mounted at the rear of the car with the display mounted in the rearview mirror or dashboard, has become a staple in mid-to-high-end vehicles to provide driver visibility behind the vehicle and reduce accidents. The National Highway Traffic Safety Administration (NHTSA) estimates that rearview cameras can reduce back-over fatalities by over 50%. This feature became a mandated safety requirement in the U.S. when government regulation was passed requiring back-up cameras for all new vehicles beginning in 2018.

Similar regulations are being considered in Europe and Asia, and automakers are already adopting rearview cameras across models. The TW9992 is a good example of an automotive video decoder IC addressing this global safety trend. It takes single-ended and differential composite video inputs from a car's rearview camera and applies its Automatic Contrast Adjustment feature to dynamically reduce or boost image brightness and contrast for greater visibility and safety. The decoder then outputs the digitized video over its MIPI-CSI2 interface to the head unit's SoC, which processes the video and sends it to the dashboard's LCD screen or rearview mirror.

Design Considerations

With rearview and other cameras becoming mainstream, cost and reliability are the two critical design concerns facing automakers. The key elements to the system cost equation are the camera and the display. Initial implementations leveraged a low cost display in the rearview mirror. As navigation units and in-dash displays have become more common, they are being used to display the rearview camera video, as well. The original designs attempted to run this video through the core processor managing the infotainment subsystem. These sophisticated SoCs introduced reliability issues due to their running increasingly complex software operating systems that are prone to hanging up (or freezing) during normal operation. In addition, these SoCs typically boot up too slowly after vehicle ignition to provide timely rear camera video to the driver.

The alternative, particularly as the load on these SoCs continues to increase, is to leverage a highly integrated video processor. This solution is essentially a "hardwired" video decoder, scaler, and LCD controller IC that works in conjunction with the SoC to address these two system issues. At initial start-up, the video processor can bypass SoC to display near immediate back-up video to the display, ensuring reliable delivery in less than 500 milliseconds.

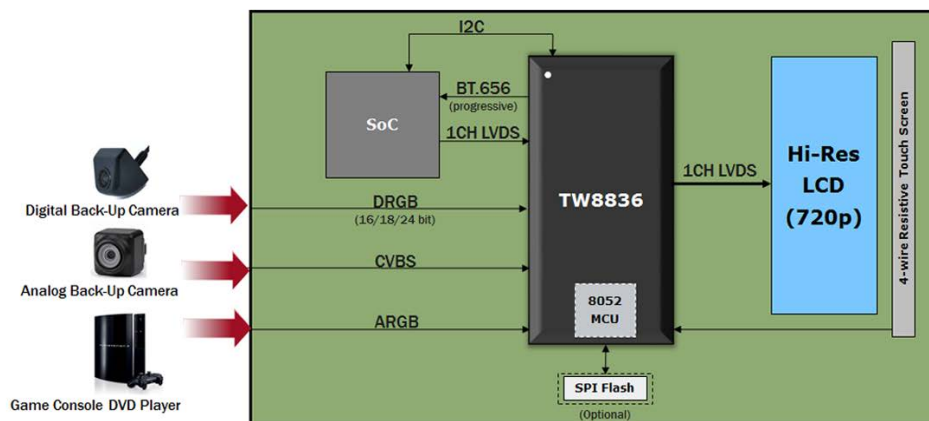


Figure 2. TW8836 LCD video processor increases vehicle safety and supports a wide variety of video sources

This approach also allows the system to detect frozen or corrupted images and bypass the SoC when necessary. The hardware bypass provides the communication integrity and reliability demanded by every major auto OEM.

An additional challenge faced by today's system architects is that most SoCs don't have enough ports available to accept the growing number of video inputs that modern vehicles require. So, while they have the horsepower to process this data, albeit not always as reliably, there is no way to immediately get the data from multiple inputs into the device. The answer is interleaving the signals together over a single data bus that requires only a single video interface to the application processor. The SoC is then able to demux and process multiple different video streams. Over time, the number of interleaved streams will increase, enabling more video inputs. The multi-channel analog video decoder with interleaved digital output approach frees up valuable pins on the SoC, which is a key design consideration.

There are also cost advantages. With as many as eight cameras per car, cost is becoming a real factor as these safety features are introduced downstream into more mid-size and economy class vehicles. High definition cameras requiring more complex and expensive processing and cabling is not cost-effective for these vehicles. Whereas, analog technology is full featured and provides reliability advantages at a much lower implementation cost.

Getting a Bird's Eye View

With automakers no longer debating the usefulness of rearview cameras, most are making significant advances to enable around view capability as a standard safety feature across car models.

An around view monitor system, also referred to as a surround view monitor, processes video from four cameras and then combines the four images into a single birds-eye, top-down view as if a camera was stationed directly above the vehicle. The monitor helps drivers visually confirm the vehicle's position relative to surrounding objects for easy maneuvering and parking. According to Infinity Research, the around view monitor application alone is growing at a compounded 33% through 2018.

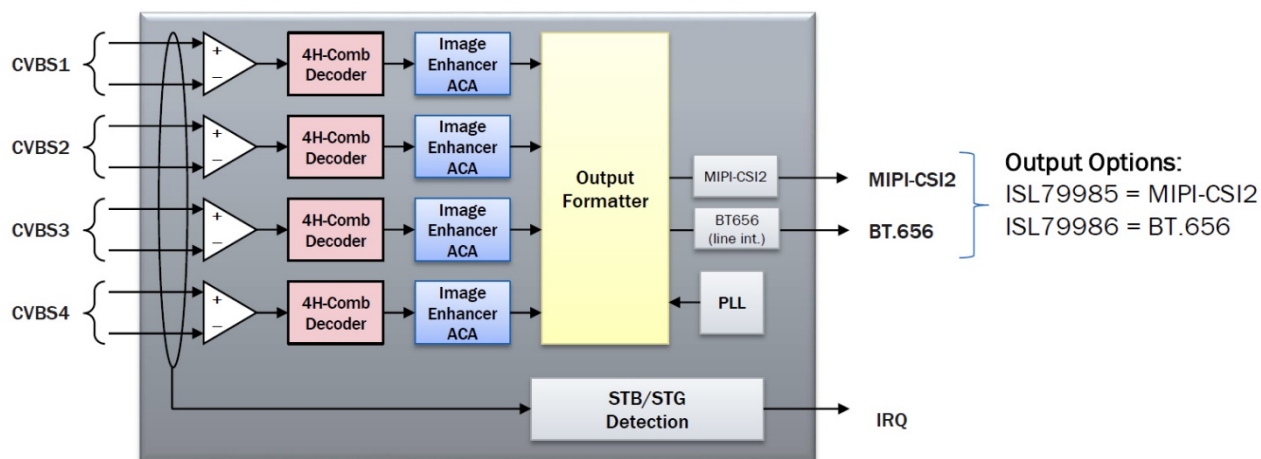


Figure 3. ISL7998x 4-channel video decoders use MIPI-CSI2 and BT.656 output interfaces to the SoC for providing ultra-clear “birds-eye” around view image to increase driver/pedestrian safety

This application has become more cost effective to implement and provides a number of reliability benefits through new multi-channel video decoder technology specifically developed for around view parking assist

applications. Integration has been a key enabler, with the latest solutions integrating four high quality NTSC/PAL analog video decoders with 10-bit analog-to-digital converters (ADCs) to support four independent analog camera inputs simultaneously. The ISL79985 multi-channel video decoder integrates a MIPI-CSI2 output interface with MIPI standard Virtual Channel Identification that is compatible with the latest generation of SoCs and application processors. The ISL79986 includes a line-interleaved traditional BT.656 interface. Both decoders send the images to a processor that can then combine the four images into a single unified around view image and transmit the combined video to the head unit display. The ability to directly receive differential analog video inputs eliminates the need for an external op amp on each input channel, further reducing component count. This high level of integration helps to simplify the system design and minimize the solution footprint to preserve critical board space and reduce the overall system cost, a key factor in enabling this capability to become more pervasive.

Flexibility is also important. Given the various possible implementations, Intersil's ISL7998x devices, along with the previous generation TW9984 and TW9966 multi-channel video decoders, offer a flexible digital output interface to support multiple configurations. This gives the system designer the ability to create a number of variations for different models without a completely new design. Designers should also be wary of video decoders and encoders with features that are more suited to building surveillance than an automotive application as they are missing key diagnostic features such as short-to-battery and short-to-ground, that further improve reliability and ensure system designers aren't paying for features they don't need.

What's on the Horizon?

Safety has become a significant differentiator over the last decade—the availability of crash test data and the ability to avoid minor dents and dings as well as serious accidents has become a real factor in consumers' choice of vehicle. ADAS, including camera safety features, have become a must-have option for new car buyers. It has changed how automakers are marketing these new features. With consumers prepared to pay for safety, features like blind spot monitors and lane departure warnings are proving to be more compelling to justify the presence of a central LCD and infotainment system than paying for the upgrade to get a better radio or navigation system. Premium additions to basic car models are increasingly centered on enabling better visibility and safety, and are proving to be a better economic proposition for the automaker as well.

There's more on the horizon as the cost of implementing safety features makes it possible to deliver them in more mainstream models. More and more video will be used to deliver capabilities like night vision and auto-brightening and darkening to improve visibility. We will also see the windshield become a head-up display for presenting key information such as driving speed, warning signals, and indicator arrows projected directly in front of the driver's line of sight. The ability to deliver reliable, easy to integrate and cost effective video solutions will be key enablers of the next generation of ADAS features, which are increasing driver safety and consumer demand for new vehicles.

Next Steps

- **Product Information**
 - [TW8836 LCD video processor](#)
 - [TW9992 NTSC/PAL video decoder](#)
 - [ISL79985 4-channel video decoder with MIPI-CSI2 interface](#)
 - [ISL79986 4-channel video decoder with BT.656 interface](#)
- [Watch how Renesas display processors boot up and display video within 500ms](#)

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