

KEEPING YOUR EYES ON THE ROAD: WHAT THE CE INDUSTRY IS DOING TO HELP YOU DRIVE SAFELY

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Foreword

This document is a report about technologies and products that help drivers drive safely while keeping their eyes on the road and their hands on the wheel. This is an overview and not a comprehensive, all-inclusive report about every product or every technology on the market.

CEA has not verified the product claims made by companies submitting information for this report. CEA makes no warranties, express or implied, with respect to the products or product claims. Users assume all risks arising from the use of such products.

It is ultimately a driver's responsibility to drive safely. The technologies and products described in this report are intended to help drivers drive safely. But, in the end, safe driving is up to the driver.

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Executive Summary

Distracted driving is a very serious problem. There are a wide variety of things that cause distraction while driving and the most common thing by a very wide margin is daydreaming, or being generally “lost in thought.” There are thousands and thousands of products on the market that aim to help people drive safely. Of these products driver monitoring systems offer the greatest opportunity to address all of the various causes of distracted driving. These systems monitor a driver’s behavior and initiate corrective action when the driver’s behavior appears to match that of a distracted person.

Introduction

Distracted driving is a very serious issue. According to Distraction.gov, the official U.S. Government website for distracted driving, 3,328 people were killed in crashes involving a distracted driver in the United States in 2012, the latest year for which data is available.¹ It is estimated that another 421,000 were injured.² In addition to this human tragedy, all drivers suffer negative consequences because insurance payouts that result from distracted driving accidents cause everyone’s insurance rates to go up.

The causes of distracted driving are varied. The most common distractions are:³

1. Generally distracted or “lost in thought” (daydreaming): 62%
2. Cell phone use (talking, listening, dialing, texting): 12%
3. Paying attention to an outside person, object or event: 7%
4. Interacting with other occupants: 5%
5. Using or reaching for a device in the vehicle, such as a portable GPS system or headphones: 2%
6. Eating or drinking: 2%
7. Adjusting audio or climate controls: 2%
8. Operating other in-vehicle device, such as adjusting the rear view mirrors, seats, or using OEM navigation system: 1%
9. Moving object in vehicle, such as an insect or unrestrained pet: 1%
10. Smoking-related (smoking, lighting up, putting ashes in ashtray): 1%

The National Highway Traffic Safety Administration (NHTSA) defines distracted driving as a driver taking his or her eyes off the road for more than two seconds.⁴ If any particular

¹ See <http://www.distraction.gov/content/get-the-facts/facts-and-statistics.html> (September 3, 2014).

² *Ibid.*

³ “Forget Phones Or Fast Food, More Drivers Cause Their Own Distractions In Crashes,” <http://www.forbes.com/sites/jimgorzelany/2013/04/03/forget-phones-or-fast-food-more-drivers-cause-their-own-distractions-in-crashes/> (April 3, 2013).

task that requires multiple glances away from the roadway cumulatively takes more than 12 seconds of eyes-off-the-road time, NHTSA also considers that distracting.⁵ NHTSA has a very precise way of measuring eyes-off-the-road time that involves measurement of the angle of the driver's eyes with respect to straight ahead.⁶

There are only two things that all distracted drivers have in common. One is that they are driving. The other is that they are distracted. The best way to address the distracted driving problem is with solutions that target these common elements.

It is important that distracted driving solutions target drivers, and only drivers. A solution that also targets passengers be they in a car, bus, train, boat or some other vehicle, will meet with resistance in the marketplace because passengers will not likely accept the restrictions intended for drivers being applied to them.

Different solutions have been proposed for different distractions. While these can be very effective, narrowly targeted solutions that address specific distractions are not the optimal way to address the overall driver distraction problem. A solution that targets the food served through drive-thru windows might be appropriate for drivers who are distracted while eating but ineffective for drivers who are distracted by other passengers. A solution that targets people who text while driving might prevent a driver from texting but also prevent an abducted child from reaching out for help. Any specific narrowly targeted solution might be effective at addressing the problem it aims to address, but because it is narrowly targeted it likely leaves some of the distracted driving problem unresolved. Furthermore, some narrowly targeted solutions might create other hazards.

There are solutions aimed at addressing all forms of distracted driving. In this report these solutions are referred to as driver monitoring technology. Advanced driver monitoring systems that address distracted driving are beginning to reach the mass market.⁷ The technology behind these systems is similar to the technology used in popular consumer electronics products like the Microsoft Kinect for Xbox 360, the Nintendo Wii, and the Sony Playstation Move. As anyone familiar with these gaming systems knows it is possible today for machines to monitor subtle human movements and take action based on these movements.

Driver monitoring systems that address distracted driving use cameras to watch a driver's eyes and head. By constantly monitoring the eyes of the driver the monitoring system can tell where the driver is looking, and even predict the driver's state of mind.

⁴ "Guidelines for Reducing Visual-Manual Driver Distraction during Interactions with Integrated, In-Vehicle, Electronic Devices," Section VI (Task Acceptance Testing) (April 23, 2013).

⁵ *Ibid.*

⁶ *Ibid.*

⁷ For example, see "Attention Assist" feature offered by Mercedes-Benz, <http://www.mbusa.com/mercedes/benz/safety> (September 11, 2014).

These monitoring systems are unobtrusive and always on. The driver does not have to do anything to activate them.

Driver monitoring systems can tell if the driver's eyes are not looking at the road ahead. They can report this shift of focus to the circuitry inside the car, and if the driver's focus remains off the road ahead for more than an allowed amount of time the circuitry in the car can take action. Some actions that might be taken include sounding an alarm, shutting off a video display, muting audio, or other similar actions aimed at getting the driver to focus back on the road.

An automatic driver monitoring system is the most appropriate and most effective way to address driver distraction because it addresses all distractions – even the ones that do not have good targeted solutions like the most prevalent distraction, daydreaming. Rather than developing a plan to get people to eat safely while driving, and developing another plan to get people to smoke safely while driving, and developing another plan to get people to use their mobile phones safely while driving, a much more effective approach would be to develop one plan to help people drive safely no matter what else they are trying to do.

In this report you will find an explanation of how driver monitoring systems work. You will also find a listing of various technologies on the market that aim to help drivers avoid specific distractions. These latter technologies are tools that drivers can use to accomplish things they want to accomplish without driving distracted.

Driver monitoring systems

Overview of technology that helps keep eyes on the road

Driver monitoring systems are able to watch a driver's eyes and determine where the driver is looking, and how hard the driver is thinking. They do this by transmitting light, which is typically in or near the infrared range, at the driver's eyes. This light is then reflected off of the eyes and this reflection is captured by a camera. The camera captures not only this reflected light but also other visible information, such as how often the driver is blinking, the size of the driver's pupils, the position of the driver's head, and so forth. When this data is combined and analyzed by embedded computer circuitry it can be used by the driver monitoring system to determine the direction in which the driver is looking, and more.

A significant amount of information can be gleaned by monitoring a driver's eyes. An eye pupil is surrounded by two sets of muscles, a circular set and a radial set. Together these muscles constrict and expand the pupil in the presence of increasing or decreasing light, respectively. But changing light is not the only reason that the size of a pupil will change.⁸ Eye pupils will also dilate when a person is deep in thought.⁹ People also blink less when they are deep in thought. It is easy to see how monitoring eye behavior is not only a way to determine if a driver is looking at the road, it is also a way to determine if the driver's mental state is not optimal. A driver who begins daydreaming, for example, may have dilated pupils and will blink less than normal. Daydreaming is very common,¹⁰ and is by far the number one cause of distracted driving accidents, accounting for nearly twice as many crash-related fatalities as all other forms of distraction combined.¹¹

⁸ "Eye-Opener: Why Do Pupils Dilate in Response to Emotional States?"

<http://www.scientificamerican.com/article/eye-opener-why-do-pupils-dilate/> (December 7, 2012).

⁹ "Ode to positive constructive daydreaming;" Rebecca L. McMillan, Scott Barry Kaufman, Jerome L. Singer; Front Psychol. 2013; 4: 626. Published online September 23 2013.

¹⁰ "The Brain: Stop Paying Attention: Zoning Out Is a Crucial Mental State,"

<http://discovermagazine.com/2009/jul-aug/15-brain-stop-paying-attention-zoning-out-crucial-mental-state> (June 15, 2009).

¹¹ "Forget Phones Or Fast Food, More Drivers Cause Their Own Distractions In Crashes,"

<http://www.forbes.com/sites/jimgorzalany/2013/04/03/forget-phones-or-fast-food-more-drivers-cause-their-own-distractions-in-crashes/> (April 3, 2013).

Eye tracking products

Delphi

www.delphi.com

Delphi's driver state sensor system uses two cameras, one located on the pillar that supports the windshield and the second camera located in the center panel of the vehicle, allowing for flexibility within the vehicle cabin for both one and two camera solutions.

The Delphi system monitors the surrounding environment and in conjunction with workload management helps determine how and when content can be delivered to the driver. In a "low demand" driving situation, such as with low traffic, in a rural or quiet traffic area, the driver has normal, full access to all of the vehicle functions. In a "high demand" driving situation, such as urban driving with high traffic and lots of distractions, the workload manager will determine that the surrounding environment requires the driver's full attention. In this case the system will provide a speech prompt for the driver to "please use voice command" for hands-free operation of the radio.

The cameras of the Delphi system can detect the direction in which the driver's head is oriented, and if the driver's head is facing somewhere other than forward for more than two seconds the system will flash an alert to draw the driver's attention back to driving with eyes focused on the road. If the driver continues to look away for more than 5 seconds the infotainment system will be disabled and another alert will flash along with an audible alert to bring the driver's attention back to the road.



Delphi driver state sensor system

Fovio

www.fovio.com

Fovio provides a platform for monitoring driver attention and vigilance that includes eye tracking technology.

Fovio technology automatically measures precisely where someone is looking. It works even when the driver is wearing glasses. Fovio's technology powers applications that increase safety and productivity in task-critical or safety-critical environments. Fovio will underpin a whole new generation of intelligent interfaces in a wide range of markets.

A diverse range of operating environments and potential users called for a universal design that suited cockpits, simulators, vehicles and consoles. Fovio's cylindrical form was inspired to generate market differentiation and flexibility of installation. Fovio will be used by Seeing Machines to develop, market and deliver contextual understanding of users. It will be used in industries that include automotive, aerospace, commercial transportation and consumer electronics.

Tobii

www.tobii.com

Tobii Eye Tracking monitors and detects the status of the driver, such as drowsiness, distraction and point of attention by following the movements of the driver's eyelids and the direction of the driver's gaze. These are the most reliable and accurate measures to warn drivers of an onset of uncontrolled sleep or critical lack of attention on the road.

Eye tracking can easily be integrated with existing safety systems, such as lane departure warning, automatic brake assist and more. Thus, the ability to prevent collisions can be enhanced to an even greater degree.

Overview of technology that helps keep hands on the wheel

By now just about everybody understands that electronic circuits can easily detect if a person is touching an object. Touchscreens are very common on smartphones and tablets, and everybody understands that the circuits in these devices can tell when a person is touching the screen.

Driver monitoring systems can function in much the same way. They are able to detect a driver's hands on the steering wheel, and conversely when a driver's hands are not on the steering wheel. One way they do this is by putting a tiny electric circuit in the