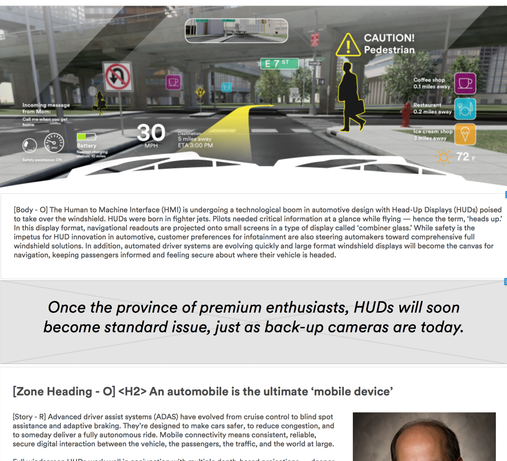
Automotive Experience and EV Solutions

[Zone Heading - O] <H1> Picturing the future of connected mobility: How HUDs are paving the way

[Zone Heading Description - O] August XX, 2018 Author: Jim Sax



[Body - O] The Human to Machine Interface (HMI) is undergoing a technological boom in automotive design with Head-Up Displays (HUDs) poised to take over the windshield. HUDs were born in fighter jets. Pilots needed critical information at a glance while flying — hence the term, 'heads up.' In this display format, navigational readouts are projected onto small screens in a type of display called 'combiner glass.' While safety is the impetus for HUD innovation in automotive, customer preferences for infotainment are also steering automakers toward comprehensive full windshield solutions. In addition, automated driver systems are evolving quickly and large format windshield displays will become the canvas for navigation, keeping passengers informed and feeling secure about where their vehicle is headed.

Once the promise of premium enthusiasts, HUDs will soon become standard issue, just as back-up cameras are today.

[Zone Heading - O] <H2> An automobile is the ultimate 'mobile device'

[Story - R] Advanced driver assist systems (ADAS) have evolved from cruise control to blind spot assistance and adaptive braking. They're designed to make cars safer, to reduce congestion, and to someday deliver a fully autonomous ride. Mobile connectivity means consistent, reliable, secure digital interaction between the vehicle, the passengers, the traffic, and the world at large.

Full windscreen HUDs work well in conjunction with multiple depth-based projections — deeper for drivers focused on the road ahead, and shallower for passengers who may be searching for a local restaurant on a Bluetooth device using gesture controls to swipe through options. It's a decidedly high-tech approach to mobility. And it's one we're working on to make a reality.

Any HUD system for automotive use must be continuously functional in extreme temperatures. It needs service longevity, optimized for the life cycle of the car. It should deliver a bright, clear projection in all lighting conditions without excessive power draw and it must fit into tight compartments. Add lightweighting and thermal efficiency into the mix and you have a lot of sophisticated engineering challenges before you, which 3M is addressing in research and development.

[Image Description] Jim Sax, Vice President of Research and Development for Automotive Electrification, 3M

I believe HUD is one of the critical technologies to embrace as the future moves towards more autonomous vehicles, playing a vital role in reducing driver distraction and providing a safer mobility experience.

[Zone Heading - O] <H2> Automobile OEMS are moving towards large format windshield HUDs

[Article Title - O] <H3> Traditional solutions use a smaller, defined portion of the windshield

[Article Title - O] <H3> Large format HUD displays can utilize all or most of the windshield

[Zone Heading - O] <H2> Solving the engineering challenges — depth, readability and ergonomics

[Story - R] Windshields aren't like TVs where you can adjust contrast and brightness or move them for better sight lines. In a HUD system, the virtual image is optically collimated and projected to a specific viewing area, referred to as an eyebox. In traditional systems this can constrict the viewing area to drivers of only average height. The core challenge for engineers is to deliver a clear and bright image in varied lighting conditions where anyone can see it. To enable depth perception, these multiple images need to appear either far away or nested near the dashboard.

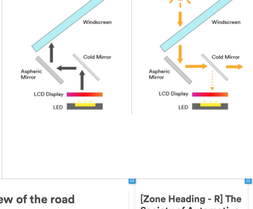
Next challenge — windshields are made from laminated double-paned glass. This results in two reflective surfaces. The nearer surface reflects a clean virtual image and the rear pane produces a blurry 'ghost image,' hindering readability. Another legibility issue arises when drivers wear polarized sunglasses. HUDs use polarized light and sunglasses block its transmission. To help address this challenge 3M is developing a transparent reflective polarizer film for laminate in-glass which can solve the sunglass problem. The same film also acts as a single reflective surface providing overall crisp images and delivers capabilities for large format multiple-depth imaging.

[Zone Heading - O] <H2> Keeping HUDs cool and connected

[Body - O] A HUD unit guides an image up to the windshield. An unintended consequence of this is that it also provides an easy channel for sunlight to strike the Picture Generating Unit (PGU). Design engineers have tackled this problem by using something called a 'cold mirror' in the light transit route. This cold mirror transmits unwanted IR solar irradiance away from the PGU. 3M has designed a reflective film which acts as a cold mirror but better. This film also transmits half of the unwanted visible solar irradiation away from the PGU.

Solar grade windscreen glass is another solution to keep the cabin interior and HUD electronics cooler. 3M produces a film to reflect IR while allowing visible light to pass through. This reduces the interior heating caused by sunlight. In addition, this film is a non-metallized solar film and thus doesn't interfere with signal relay for transponders, GPS, satellite radio or cellular data.

All of this is important for projecting augmented reality or 'AR.'



[Zone Heading - O] <H2> An augmented view of the road

[Story - R] Most drivers have experienced this scenario at one time or another: Driving on a residential street; a ball bounces onto the pavement in front of you. You instinctively tap the brake, knowing how likely it is that the ball will be followed by a running child.

Advanced safety features using cameras and lidar can track the child and project outlines to the head-up display to quickly alert the driver.

The most difficult challenge facing design engineers is to project this augmented image at an apparent depth where the driver is already focused — so he or she and can best react — as well as maintaining multiple-depth perception for driver information display.

A human machine interface which utilizes AR, requires that drivers and passengers adapt to the technology. Auto designers want to deliver a simple, out of the box user experience and are acutely aware of digital overload, i.e., too much information. Incidental information like fuel or battery levels might be projected in a marginal field of view where they wouldn't create a distraction.

[Zone Heading - R] The Society of Automotive Engineers (SAE) identifies 6 levels of automation

[Story - R]
Level 0: No automation
Level 1: Driver assistance
Level 2: Partial automation
Level 3: Conditional automation
Level 4: High automation
Level 5: Full automation

In augmented reality, a computer-generated image is superimposed upon a user's view of the real world. This is the promise of next-generation HUD.

[Zone Heading - O] <H2> As cars become autonomous — intelligent design will need to keep pace

[Story - R] In higher levels of automation, travelers make destination choices and the car's computer navigates the course, taking on safety-related operational decisions without human input. As vehicles — and their human occupants — make the transition to levels 4 and 5 of autonomy, it's important that cars communicate their actions to occupants. This means alerting passengers to intended routes, lane changes, turns or other directional actions so they can be assured that actions being taken by the car are intended. No one wants to be in an autonomous vehicle that suddenly makes a sharp turn without warning. By projecting navigational imagery with AR on any window of the cabin, all occupants will know the vehicle's intended actions, and will feel secure, informed and comfortable.

In addition, communication with pedestrians outside of the car is important when vehicles operate without passengers. In these cases, HUDs might deliver signals to pedestrians and others outside. Windows that passengers would look out of could move from a passive transparent state to an electrified backlit state for the convenience of the outside observers. Think of an electric rear-view mirror or 'eMirror', which works the same way.

[Article Title - O] <H2> There is a revolution underway in the cockpit of the vehicle

The advancements I'm describing here have given automobile engineers many a sleepless night. If there will be more HUDs in a vehicle, where will the units be concealed? Can we make them smaller and more powerful but use less power? How do we control reflections from the other displays in the car? What about reliability? Software can be updated but no one wants to pull open a wall panel for a HUD repair. Perhaps because of these interrelated challenges, the industry is looking at a more agile approach to designing cars — bringing cabin interior designers to sit at the same table with the power train specialists and battery teams — planning and creating together.

As we develop light-manipulating materials that enable a HUD unit to use less energy; it means less heat, less required space for heat dissipation material, and less load on the climate control system to maintain cabin comfort.

[HTML 3 - O] —John VanDerlofske, 3M Senior Research Scientist

[Zone Heading - O] <H2> We believe in cascading benefits

[Story - R] In our own labs at 3M, we've found that by drawing on a diverse team of engineers, each one an expert in their own technology areas; we can solve some of the most complex challenges.

3M has a long track record of manufacturing optical films and adhesive materials for vehicles, and we're no stranger to huge industry transformations. Through our collaboration with leading consumer electronics companies, we transformed electronic display technology and enabled mobile communication platforms to move from basic telephones to become mobile multifunctional computers. We're leveraging these technologies every day to create innovative solutions for the next-generation of the mobility industry.

As the automotive landscape evolves, we're committed to making smart, efficient products that remove design constraints. If we can maneuver light to make a display brighter using less energy, or make a solar-grade film that allows you to remove the mechanical sunshade, we can help create an automotive ecosystem with a smaller carbon footprint and ultimately reduce costs.

[Zone Heading - O] <H2> Engineer to engineer

[Abstract - R] We thrive on bench to bench collaboration within our organization and with the industry. Automobile OEMs have told us that having a 3M engineer embedded within their team provides acceleration in the speed of development. And we learn from design engineers too. If you're interested in further discussion about how 3M can collaborate with your team or want to learn more about our automotive solutions, please reach out.

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