

Head-Up-Display(HUD) for Automotives

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Introduction:

Automotive Head-Up Display is a transparent display installed in such a way that the driver does not have to get diverted from their viewpoint while driving. It is mainly installed on the dashboard, and the results are shown on the projector. Automotive Head-Up Display is a new concept that is used now in higher-end vehicles as of now. Noticing the security benefits, there are chances that it can be used in other cars in the coming future.

Types of HUD:

Automotive Heads-Up Display can be divided into

Combiner HUD:

Combiners are semitransparent surfaces used in the head-up display (HUD) and augmented reality (AR) systems to overlay an image presented by a projector on top of the viewer's physical world. The combiner is transparent and lets the viewer see through it while simultaneously reflecting dynamic digital information.



Figure showing Combiner HUD.[1]

Windshield HUD:

Windscreen Head-Up-Display shows a virtual image, but not as a flat, static picture on the windshield, but rather as “floating” over the hood at a distance of about two meters. In passenger car windshield HUD, the HUD projects light onto the interior of the car’s windshield, reflecting toward the driver, enabling the driver to see the critical vehicle and environment information on the windshield. The curvature of the car’s windshield is carefully matched with the projection system component of the HUD system to optimize the display in the driver’s field of view. OEMs place extreme importance on ensuring that the driver sees a distortion-free image directly in the field of view.

The windshield HUD system, which uses no separate combiner but projects data via virtual images in front of the windshield. Its optics are more complex and its cost is higher than the other systems. While the same combiner HUDs can be designed into different positions and locations in different types of vehicles, windshield HUDs must be designed for a specific windshield and are not as adaptable.



Figure showing windshield HUD.

Augmented Reality HUD:

Augmented reality (AR) head-up displays (HUDs) are the next evolution toward creating a better driving experience. By placing graphics directly in the driver's line of sight that interacts with and augments real-world objects, AR HUDs can significantly improve driver situational awareness.

In the case of an Augmented Reality Head-Up-Display, the information of the windshield HUD is enriched with a layer of information right on the street in front of the car. The head-up display uses AI to spot and highlight crosswalks, pedestrians, and potential collisions. Augmented-reality HUD that displays lane edges, objects in the road, and other information important to drivers.

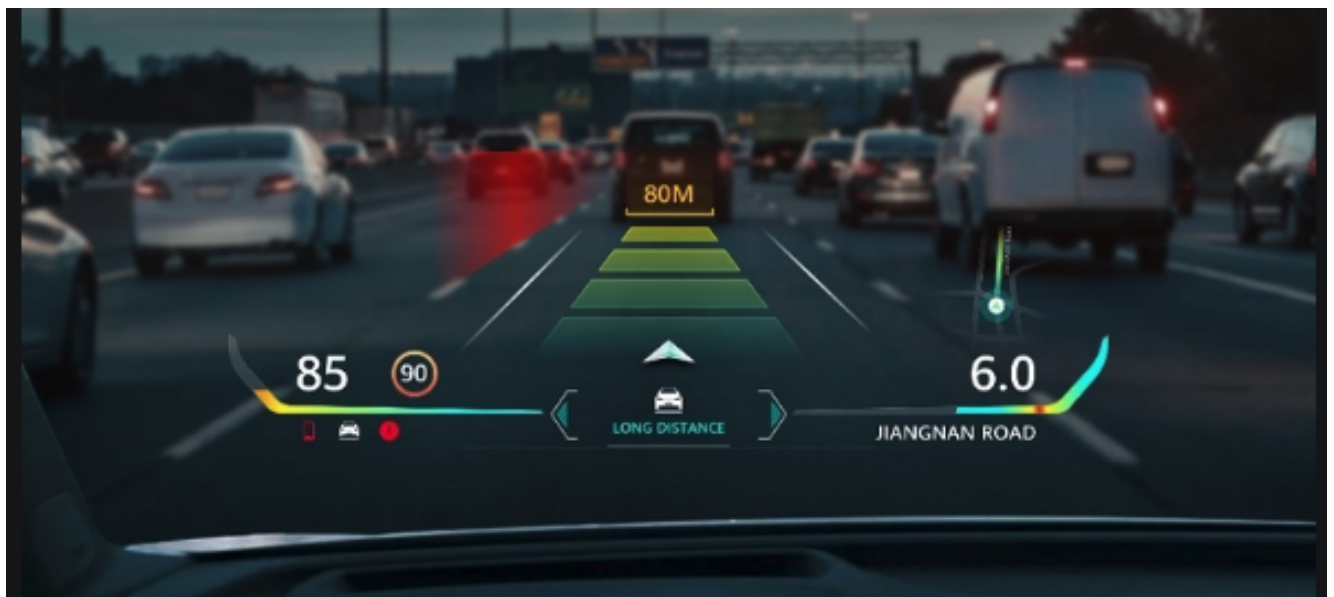


Figure showing augmented reality HUD.[1]

Current Market:

The automotive HUD market is estimated to be worth USD 866 million in 2020 and is projected to reach USD 3,372 million by 2025, at a CAGR of 31.3% during the forecast period. The market is driven by increased customer awareness about road and vehicle safety, demand for improved consumer experience in vehicles, and high growth in the luxury and high-end cars segments, mainly in the emerging markets.



Technological advancements are driving the automotive industry to the next level. Features such as driver assists and surround-view cameras that were once available exclusively in luxury vehicles now come as a standard even in some economy cars. The same thing is slowly happening with head-up displays (HUD). For example, the 10-inch HUD in the 2018 Toyota Camry is one of the largest and best HUDs used in any car.

Mazda is another mainstream brand that offers HUDs in several of its vehicles. But instead of embedding expensive components in the dash and using a special windshield, the HUDs in the Mazda3 and Mazda6 use a thin plastic lens that folds down when not in use. MINI has a similar solution, but this low-cost approach has limits in terms of size and position of the images compared to traditional HUDs that use the windshield as a screen.

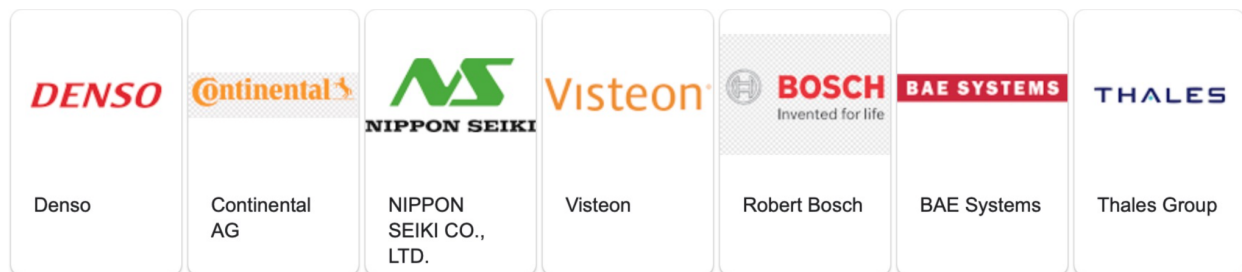
North America is estimated to be the largest automotive HUD market for passenger cars. It is expected to remain the most dominant market for automotive HUD during the forecast period.

The passenger car HUD market in North America and Europe is driven by the increasing adoption of HUDs in the new vehicle models sold in these regions. In 2017, there were more than 25 passenger car models and variants in the US with a standard or optional HUD, up from 10 models a decade ago.

Current Players

The global head-up display market is expected to exhibit strong growth during 2021-2026. The leading players in the head-up display (HUD) market focus on R&D activities to introduce innovative products. They are also collaborating with car manufacturers to launch HUDs in the middle car segment. This can be attributed to the significant increase in installing active safety systems like HUDs in automobiles due to rising incidences of road accidents. Apart from this, rapid urbanization and inflating income levels have also encouraged the demand for luxury and high-end cars.

Some of the leading manufacturers and suppliers of the automotive HUD market are [Bosch](#) (Germany), [Continental](#) (Germany), [Denso](#) (Japan), [Visteon](#) (US), [Nippon Seiki](#) (Japan), [Panasonic](#) (Japan), [Pioneer](#) (Japan), [Yazaki](#) (Japan), and others. These companies adopted inorganic and organic growth strategies such as new product developments, expansions, supply contracts, collaborations, partnerships, and mergers & acquisitions to gain traction in the automotive HUD market.



Continental:

Multi-Display Solutions - Today's displays are as individual as today's cars. Forms and functions follow brand-specific design philosophies. New degrees of design freedom is enabled by the seamless integration of multiple displays into 3D shaped freeform surfaces and enable new User Experiences. Our technologies allow a nearly endless variety of forms and shapes.



Transparent Vehicle and V2X improve traffic safety - Continental's Transparent Vehicle technology gives drivers a full view of a vehicle's surroundings. Utilizing four cameras, it captures images from around a vehicle and then applies Continental's proprietary algorithm to stitch them together through a control unit. The result is an unobstructed view of the surroundings from any angle, which allows for safer low-speed maneuvers and parking. By giving drivers a new perspective, Continental's Transparent Vehicle technology can improve safety and reduce crashes.

<https://www.continental.com/en/press/press-releases/20211115-ces-innovation-award/>
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Privacy Display -



November 12, 2021 Continental's newly developed Switchable Privacy Display for in-car use allows the passengers to enjoy multimedia content without distracting the driver.

Nippon Seiki: Announced an investment of JPY 1 billion in order to expand the production capacity of its HUD and to establish a new production facility, which can manufacture onboard gauges and displays in Lodz, Poland. The new facility will start full-scale operations by October 2020.

HUDWAY: HUDWAY Glass is a neat lightweight phone mount designed to make a smartphone operate as a head-up display. Its tinted plastic lens has a mirror coating for crisp easy-to-grasp reflection. This way, you can see both the road ahead — and directions reflected on the lens in front of your eyes. For users who are not looking to buy a new vehicle.

Challenges

Building AI model: The technology is aimed to assist in driving by using Artificial Intelligence. Building effective AI models will require a huge amount of data to cover every scenario. The best way to collect the data set is to traverse the roads which will take time to build the best model. Yet another challenge is to gather the data set for the conditions when the road conditions are unpredictable. Data collection will require collecting telemetry about roads but also for the same route under different conditions.

Experts believe that human drivers are still generally better than an AI at making nuanced decisions about how to most safely pilot a vehicle in bad weather, in chaotic urban environments, or when something truly weird happens on the roadway that a computer can't possibly be programmed to predict. So even though augmented reality HUD can be added to cars, the intelligence of human drivers will always be needed to avoid accidents.

Competition: There are startups and publicly traded companies such as Apple interested in providing augmented reality HUD technology to automotive companies. Each of the players is building a good patent portfolio. For example, Envisics has around 250 approved patents and 160 pending patents. It is highly likely when a product of one company is introduced in the market, other companies will start patent litigation. It may become a similar scenario as Apple and Samsung litigating over features of phones.

Automated Actions: Augmented Reality HUD aims not only to assist the drivers but also to automated actions. Suppose a driver checks himself out in the rearview mirror, and a kid chases a soccer ball into the street in front of his car. In that case, the alert system will blow extra loud and flash a warning directly into the motorist's field of vision to give him an alert to stop. These automated actions will only be applicable in lanes such as highways or countries where rules are strictly followed. If the car is being driven on a crowded street, which is very common in Asian and European countries, automated action will be annoying.

The incentive for Auto Manufacturers to Adopt Technology: Augmented reality HUD is being developed to assist drivers. Companies such as Google, Tesla, Cruise are also focused on building self-driving cars. It also has to be noted that the augmented reality HUD can only be added to the new vehicles. With competition from the Self Driving technologies, which are being developed and experimented with, automotive sectors may require incentives for incorporating augmented reality HUD in their vehicles. Instead of investing in building plants, getting suppliers, and parts for augmented reality HUD, automotive companies might as well wait for self-driving technology to get widely adopted and extend the driverless feature in their vehicles.

Other Factors:

The COVID-19 pandemic has decelerated the growth of the automotive HUD market. Lower vehicle sales are likely to weaken the demand for vehicle and passenger safety features. Nationwide lockdowns and suspension of major business activities by OEMs have delayed the testing of semi-autonomous driving systems and advanced safety features. The lack of interest from OEMs in investing in advanced technologies for the next one or two years will be a major setback for automotive HUD manufacturers, and the automotive HUD market is estimated to witness a dip in 2020.

Technical Limitation :

The windshield-projected HUD requires a large amount of space in the cockpit of an automotive. Advanced HUDs such as augmented reality head-up displays (AR HUD) help make driving more comfortable and safe by superimposing the exterior view of the traffic conditions in front of the vehicle with virtual information (augmentations) for the driver. The reflected information appears to be part of the driving situation itself. However, augmented reality HUDs take up substantial space on the dashboard.

The hardware associated with full windshield augmented reality HUD takes up greater automotive cockpit space, which would require enormous automotive cockpit re-designing effort from OEMs. The initial AR HUD model developed by Continental AG (Germany) requires 13 liters of cockpit space, which is difficult for the OEMs to incorporate. Reducing the size of the augmented reality head-up display could reduce the clarity of the augmented image, causing it to be less legible to the driver. To make the projection available precisely in the driver's field of view, iris recognition devices and gesture recognition devices will need to be integrated with the HUD. The large space required for embedding an augmented reality head-up display in the automotive cockpit is a key restraint for OEMs and the automotive HUD market.

Why will the HUD market thrive?

The navigation screens became essentially the central computer monitor for the car, through which every function of the automobile now is displayed, from audio streams to climate control to mood-lighting settings, and still showing navigation information.

To provide a legible platform for all of this information, of course, the screens have grown in height and, mostly, width, to the point where nav-screen size has become an important indicator of just how upscale a vehicle is.

Unfortunately, at the same time, many automakers and their tech suppliers have done a poor job of designing the screens and associated controls to be truly user-friendly. Information isn't

laid out plainly or comprehensibly; it takes too much effort to get to the data point a user wants; drivers are required to do too much manual manipulation of associated screen controls in the center console. There's just too much going on.

Head-up displays will become more important as the central conveyor of the information that will be most crucial to drivers as the industry heads further into the era of autonomous driving.

Head-up displays are going to be the third leg to this stool of autonomous driving and EVs. They will be the key to transitioning from driver control to semi-autonomous control because head-up displays aren't going to be the battleground for control that the nav screen has become.

We feel that AR HUDs are destined to become the most important display of a car or any moving vehicle, showing us what matters most in any situation. While AR HUDs will not completely obviate the need for other displays, only an AR HUD is able to put prioritized information directly in our field of view, enabling the shortest possible reaction time to what's happening around us.

Technical evolution:

Automobile manufacturers and HUD suppliers have been continually working in developing better systems for cars. Utilizing advanced technologies, like liquid crystal display (LCD) and light-emitting diodes (LED), delivers the advantage of displaying bright, vibrant images on the windshield. The consistent technological advancements have evolved them to be less expensive to manufacture. The new projection technologies, including micro mirror-based devices based on electromechanical systems, are coming into the market, which will aid in creating brighter displays with the usage of more colors. The factors that are expected to drive the growth of the display systems market are the low cost and innovative display technologies.

The Road Ahead:

Head-up displays were earlier available majorly in luxury cars, but now, OEMs have been thinking and making them standard even in economy cars. In 2018, Japanese manufacturer, Toyota, launched Camry with the largest windshield HUD compared to many other cars available in the market. The company has also made windshield HUD as a standard for its Prius model.

Continental AG offers Adaptive Cruise Control, which uses AR-based HUD to display and monitor the speed and distance ahead of the cars. A crescent-shaped icon on the display changes its color to provide uninterrupted feedback when the vehicle ahead gets too close. The display panel plays a critical role in the augmented usage of the driver assistant systems in the vehicle.

Automotive OEMs such as Hyundai (Korea), Suzuki (Japan), Toyota (Japan), and Volkswagen

(Germany) face the challenge of installing advanced head-up displays with augmented reality functions in mid-segment vehicles. Over the next decade, these systems are expected to become a standard feature in passenger cars across several countries.

Similarly, when the vehicle is parked, the windshield can literally become a full-on entertainment display for the passengers providing the ability to play video games, split-screen entertainment, and even attend video calls.

Specially manufactured windshield screens can enhance users' visibility in poor light and be custom developed using 3D printing technology.

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