EXEMPLARY LANDSCAPE REPORT ON AUGMENTED REALITY-HEAD UP DISPLAY

Image Source: Continental AG

Content

- Introduction to AR-HUD
- Applications of AR-HUD
- Growth Prospects of AR-HUD
- Objectives of the Landscape/Study
- Assumptions for the Instant Landscape Analysis
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Introduction to AR-HUD

What is Augmented Reality- HUD ?

AR-HUD is a head-up display that incorporates the augmented reality technology which guarantees an advantage over normal head-up display.

- The Augmented reality head-up displays will help to make driving even more comfortable and safe. This generation of HUDs supplements the exterior view of the traffic conditions in front of the vehicle with virtual information (augmentations) for the driver.

- The augmented reality head-up display differs from a normal windshield-HUD since the reflected information appears to be part of the driving situation itself.

- When navigating, for example, a virtual symbol inserted precisely into the exterior view marks the route that the driver should follow on the road ahead.

- AR-HUDs may become large enough to fill the whole windscreen and present an "augmented reality" view to the driver. ADAS features such as pedestrian warning, blind-spot detection or night vision could be overlaid to fill the whole windshield.

Source

Advantages of AR-HUD

- The augmented reality head-up displays will help to make driving even more comfortable and safe.
- This generation of HUDs supplements the exterior view of the traffic conditions in front of the vehicle with virtual information (augmentations) for the driver.
- The augmented reality head-up display differs from a normal windshield-HUD since the reflected information appears to be part of the driving situation itself.
- When navigating, for example, a virtual symbol inserted precisely into the exterior view marks the route that the driver should follow on the road ahead.
- When distance controls (adaptive cruise control, ACC) are enabled, a marking in the AR-HUD visualizes which vehicle in front is detected by the assistance system.
- In a world that is becoming increasingly complex, the AR-HUD relieves the burden on the driver because what the driver's eyes see is directly connected with explanatory information.

AR-HUD Applications

1) Lane departure detection and alerts

Image source: Continental

- When cruising on a long stretch, it's easy for the driver to get comfortable and be less attentive.
- AR-HUD solution supports a critical feature to address this issue—lane departure detection and alerts.
- So even if the driver is gradually, but not very noticeably, veering to one side, the AR-enhanced HMI will display a simulation of the lane and alert the driver.

Continue…

2) Vehicle proximity detection

Image source: Continental

- Using sensors and vehicle-to-vehicle communication, your car can now read the distance between itself and other vehicles.
- AR-HUD system displays this information on your windshield, with symbolic and color-coded alerts and simulations that warn of too much proximity and keep you at a safe following distance.

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3) Blind spot detection and 360 view

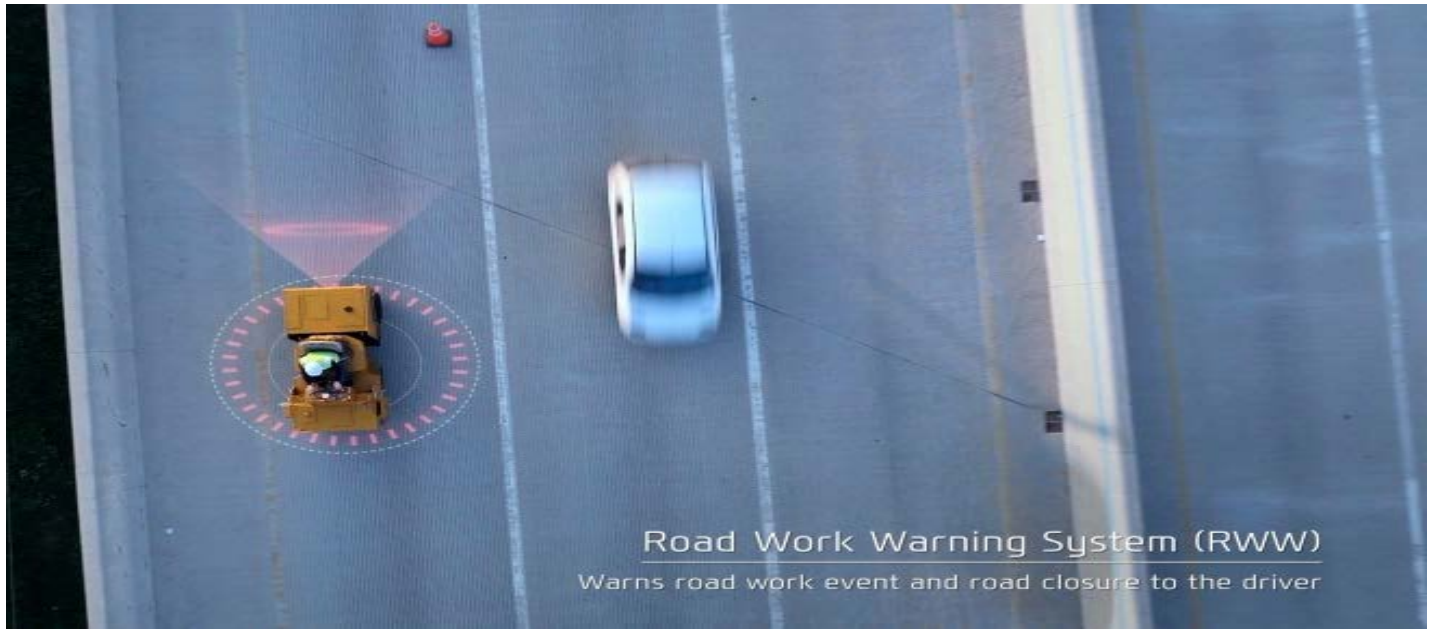

Image source: Hyundai

- The Car HUD system fetches data from the integrated cameras. These cameras capture the view from different sides of the car, and also track the driver's movements and line of sight.
- This ensures that information displayed on the HMI of AR-HUD solution is adjusted to the driver's field of vision, thus aiding blind spot detection.
- The cameras, in some models, are also able to project a 360 aerial view of the vehicle.

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4) Pedestrian detection and alerts

Image source: Hyundai

- Using vehicle-to-people communication, the AR-enhanced car HUD solution alerts the driver of nearby pedestrians and objects that come in the collision path of the vehicle.
- The sensor and camera-based simulations and early warnings usually give the driver sufficient time to react and facilitate a less anxious driving experience.

Continue…

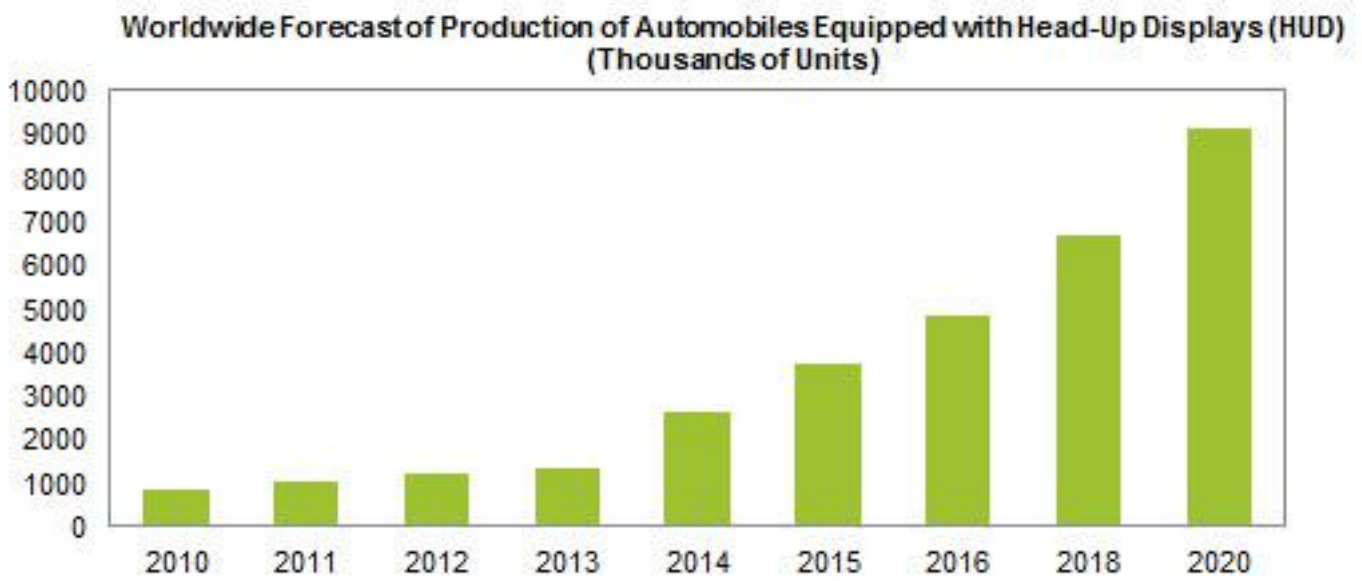
5) Route navigation alerts and road sign simulations

Image Source: Texas Instruments

- When you're on the road, stuck amidst traffic or zipping on the freeway, smart navigation can make you a better driver and ensure an enjoyable driving experience.
- This means no need for sudden turns or the realization that your exit is actually too close for you to shift lanes towards it. That is where augmented reality gives early alerts regarding upcoming turns and lane changes, guiding you to the appropriate lane for your route.

Growth Prospects of AR-HUD Technology

- IHS Automotive predicts worldwide sales of HUD-equipped vehicles to grow from 1.2 million in 2012 to 9.1 million by 2020 – and that's not taking into account aftermarket HUD solutions for consumers to use in their existing vehicles.



Source:IHS Inc. June 2013

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- One key area driving the future of automotive HUD is augmented reality (AR).
- AR HUD enables the windshield to become the focal point for all relevant data such as speed and road hazards, while keeping the driver's eyes focused on the road ahead. While work continues on deciding what relevant data should appear – and when – there are several technical considerations to keep in mind when designing an AR HUD.

Field-of-view (FOV) and virtual image distance

Field-of-view is perhaps the most important aspect of any HUD solution, especially for AR HUD, because it directly impacts the size of the image the driver sees.

Image quality

It's important to note that image quality doesn't necessarily equate to higher resolution in this scenario. Image quality involves several variables including image refresh rate, colour depth, brightness, etc.

- Unlike the local movie theatre, it can be very challenging to control the image quality in a chaotic and somewhat unpredictable outdoor automotive environment. The varying light levels throughout the day and night mean any automotive AR HUD solution must be able to maintain deep, accurate colours and consistently high contrast ratios to work across a range of driving conditions.

Continue…

Development options

- Most automotive AR-HUD solutions require developers to collaborate on a solution that meets the needs of their products and customers.
- HUD solutions are typically part of an integrated solution featuring advanced driver assistance systems (ADAS) and other components that work collectively to deliver an improved driving experience.
- Understand technology and patent landscape.
- Understand major patent holders, geographical distribution of patents, top sub-technologies based on classification codes.
- Analysis of patent filing trends over the years, top assignees, top patent classifications, among others.
- Conduct problem-solution approach based study of patents relating to applications of AR-HUD in market

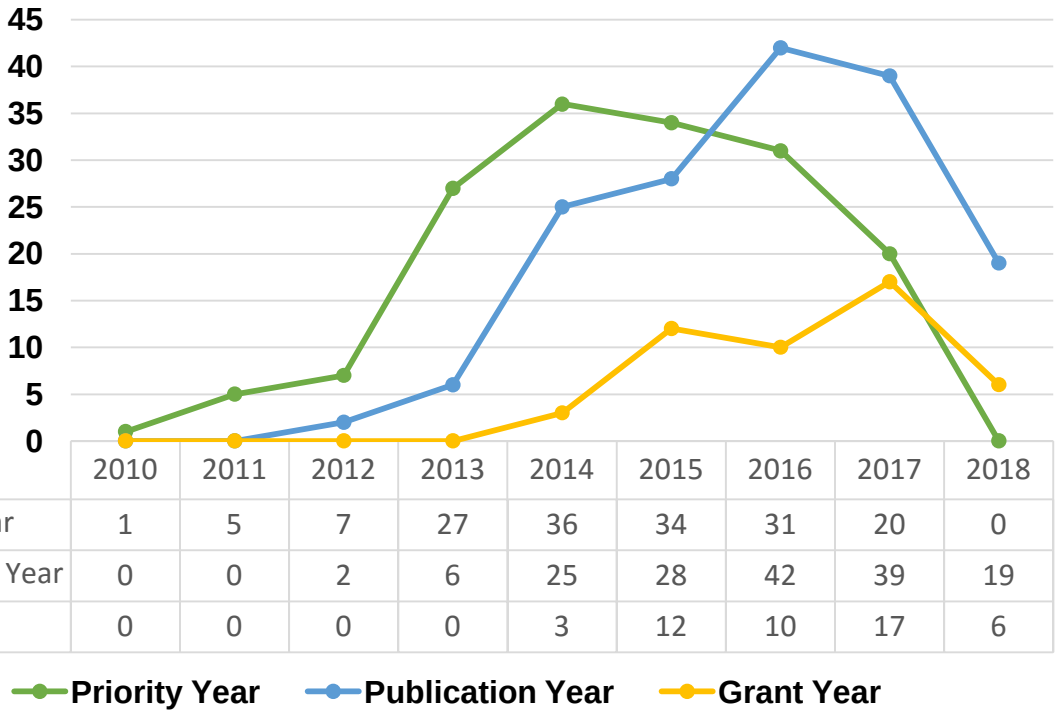
Assumptions

- Report provides patent analysis for AR-HUD market, which includes study of manufacturing of AR-HUD, applications, and advance technology based patents in Automotive Industry.

- The study was focused to find out patents pertaining and solving prior art problems related patent with respect to its application.

- The study does not focus on patents pertaining to Augmented Reality in various fields, e.g. Commercial, Military, Education and Gaming; have therefore not been analyzed part of the study.

Filing, Publication, Grant Year Based Trends

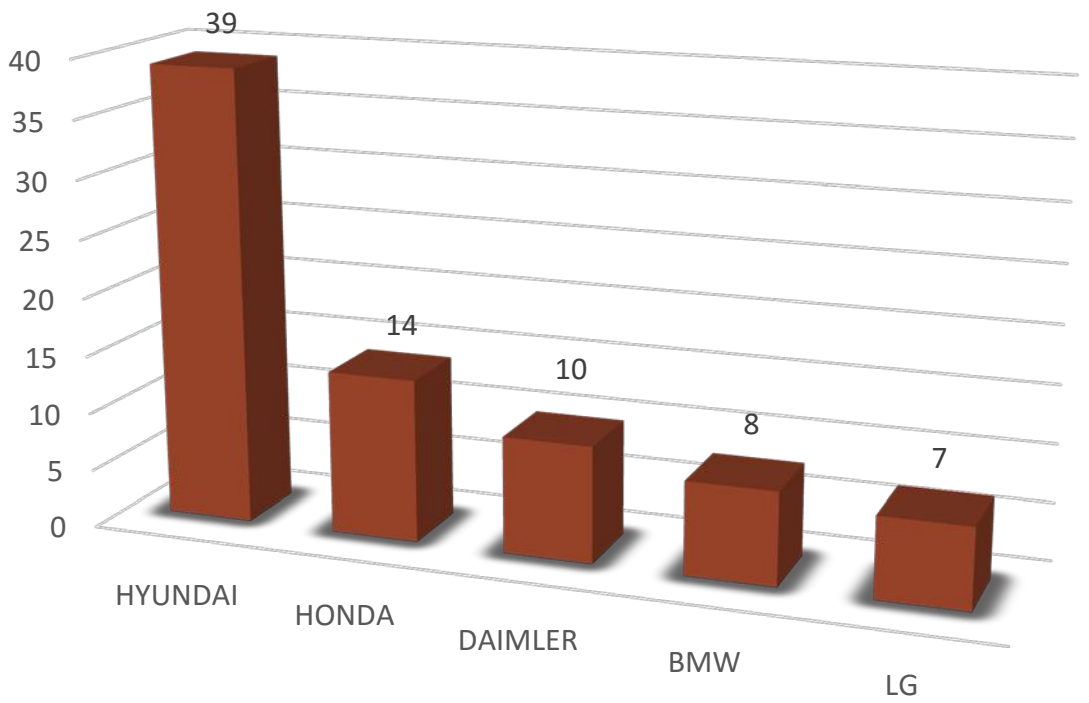


	2010	2011	2012	2013	2014	2015	2016	2017	2018
Priority Year	1	5	7	27	36	34	31	20	0
Publication Year	0	0	2	6	25	28	42	39	19
Grant Year	0	0	0	0	3	12	10	17	6

Insight

- Application Filing Trend indicating a consistent rise in the number of patent applications being filed. As evident, year 2014 has seen highest number of application filings, followed by the 2015 and 2016.
- Application Publication trend indicates a gradual rise in publication during year 2014-2017. Highest number of patents were published in the year 2016.
- Grant Trend indicates that the highest number of patents were granted in the year 2017.

Top Assignees Based Trend

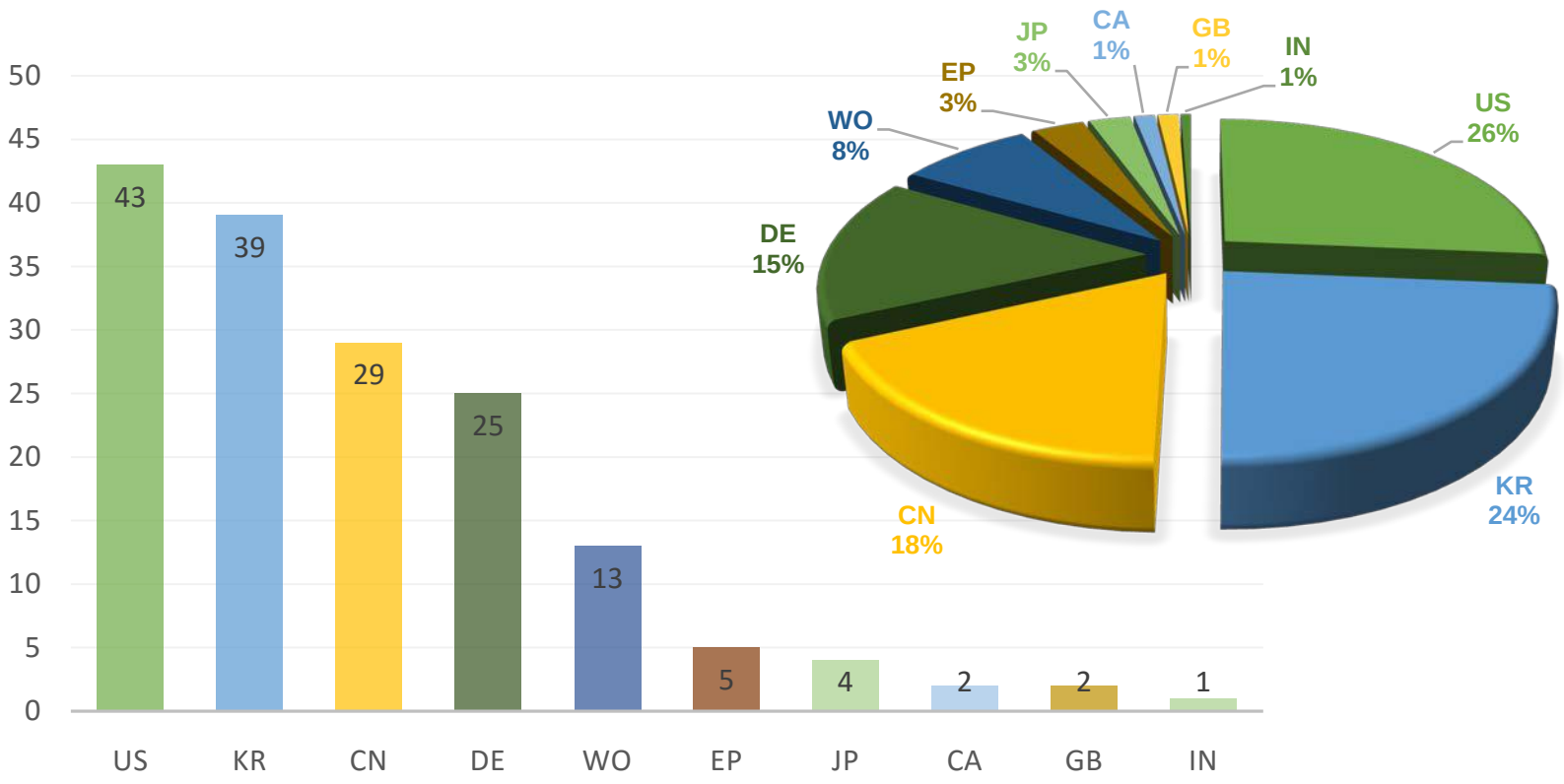


Insight

Hyundai is among leading patent filers in AR-HUD Technology, followed by Honda Motor, which also has a significant patent portfolio.

#Graph was prepared based on the analysis of application year for published applications (based on the representative family numbers)

Geographical Origin of Innovation Based Trends

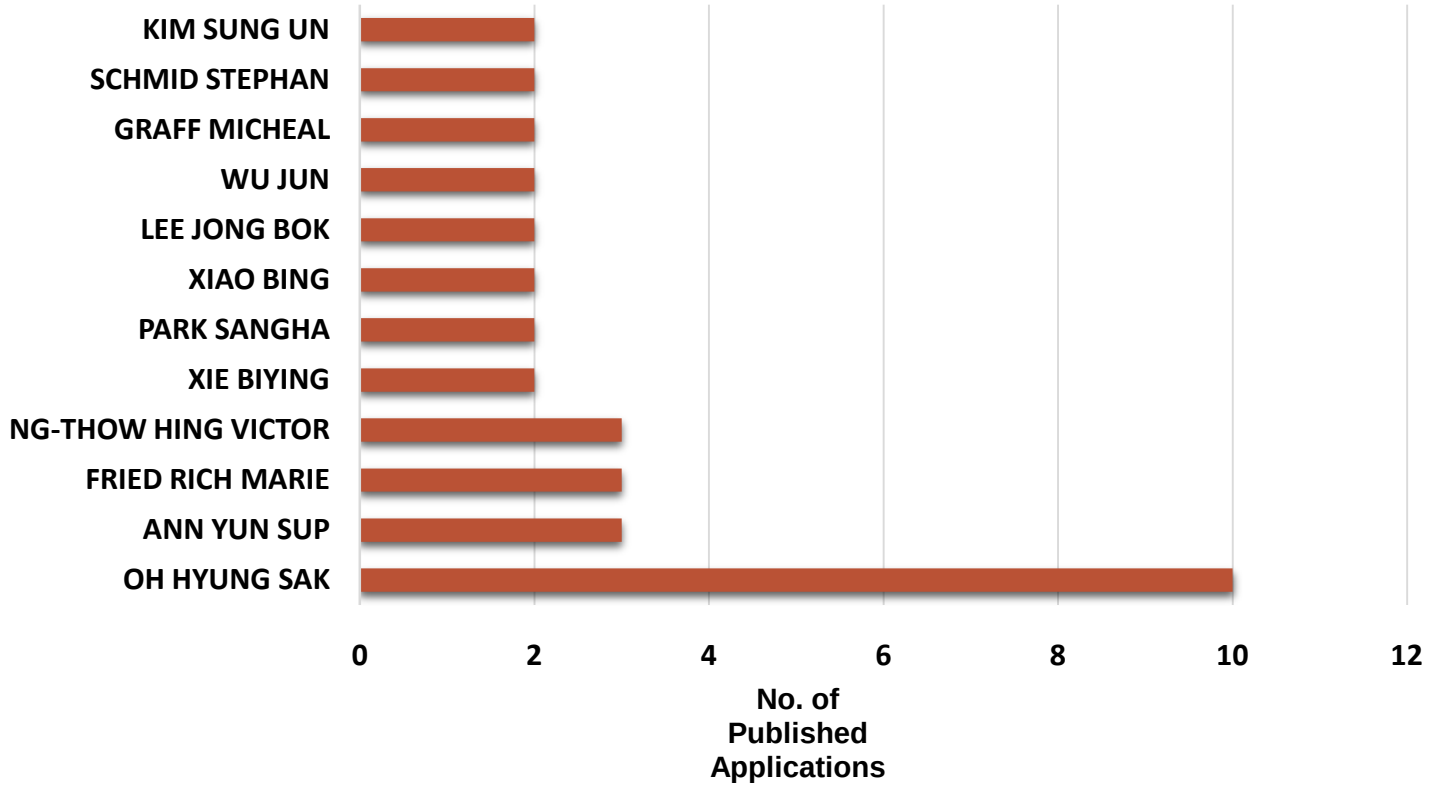


Insight

Trend related to Geographic Origin of Innovation demonstrates that maximum number of innovations were originate in the US followed by KR and CN jurisdictions.

The graph representing Geographic origin of innovation was prepared based on the analysis of priority country

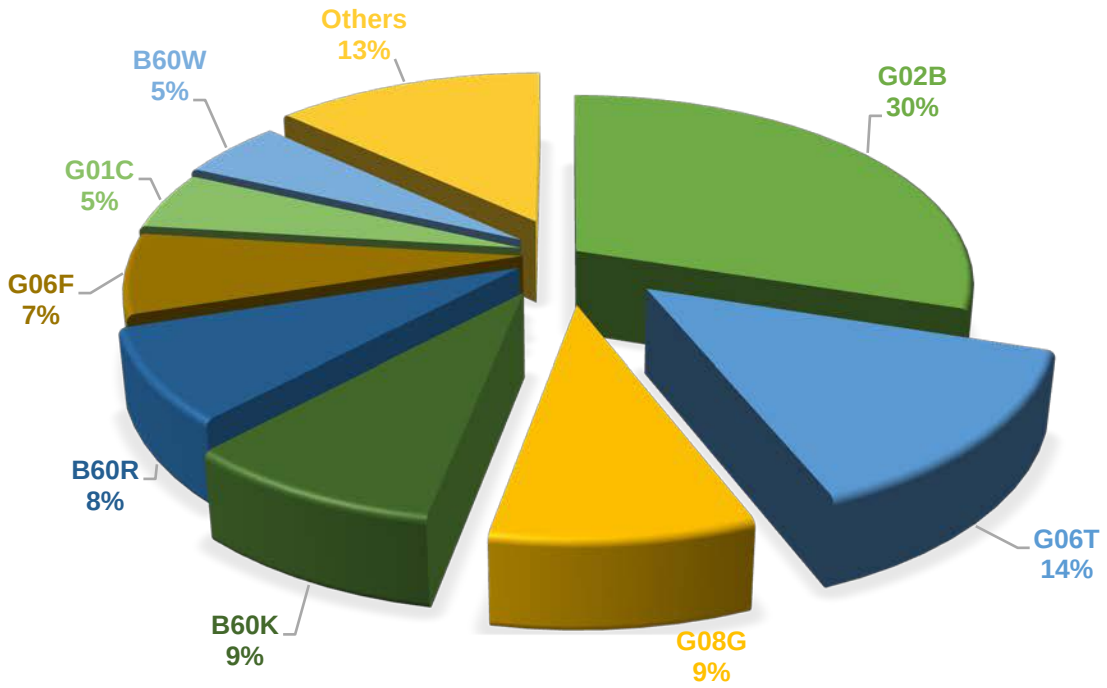
Top Inventors Based Trend



Insight

Top inventors trend demonstrates that ‘Oh Hyung Suk’ is among the leading inventors in AR-HUD Technology followed by Ann Yun Sup, Friedrich Marie and Hing Victor.

IPCs Based Trends

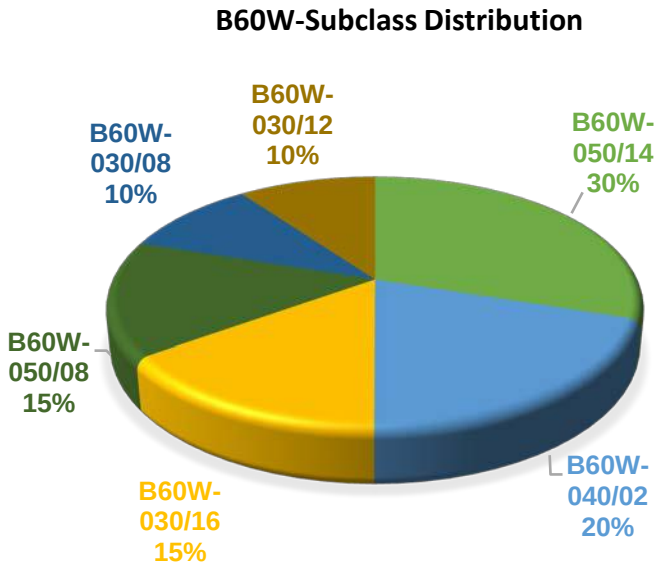


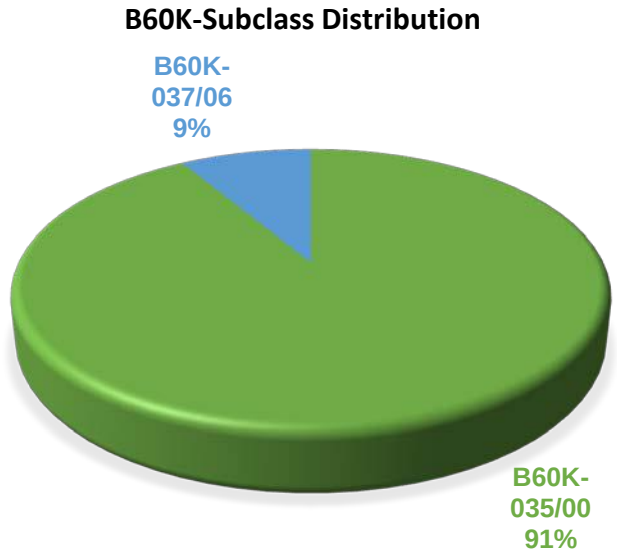
IPC SUBCLASS	DEFINITION
G02B	Optical Element Systems
G06T	Image Data Processing
G08G	Traffic Control Systems
B60K	Auxiliary Drives
B60R	Vehicle Fittings
G06F	Electric Digital Data Processing
B60W	Conjoint Control of Vehicle
G01C	Measuring Distance

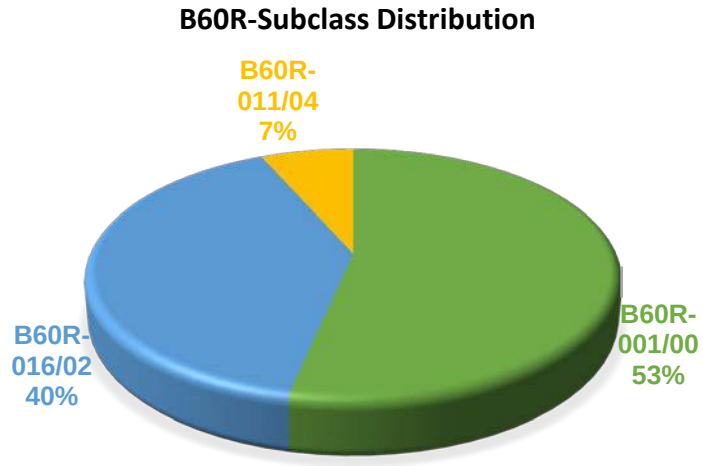
Insight

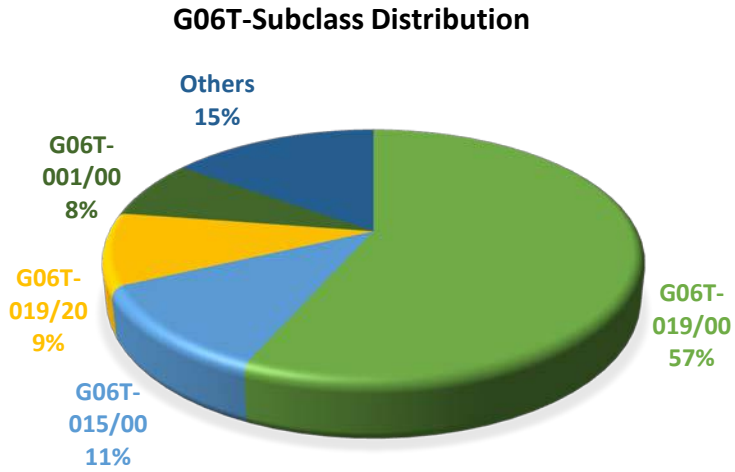
Majority of patent applications were assigned with IPC “G02B” followed by “G06T”.

IPC Sub Class Distribution









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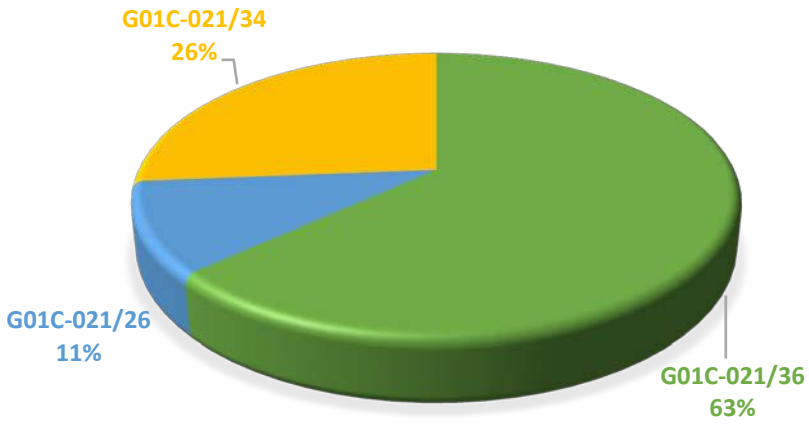
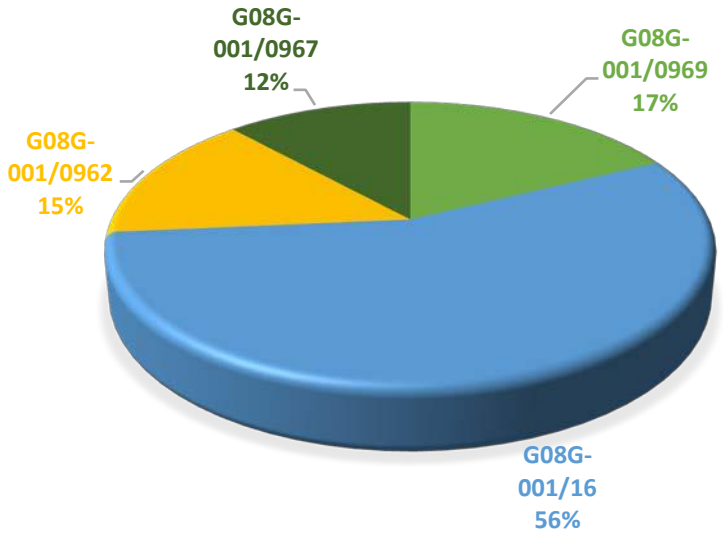
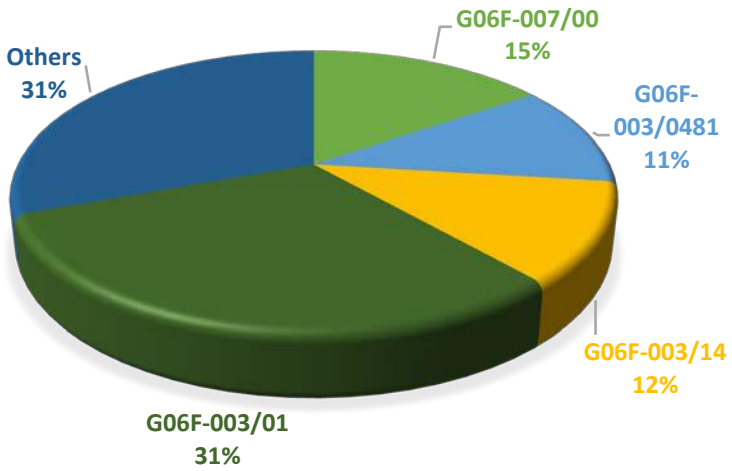
G01C-Subclass Distribution



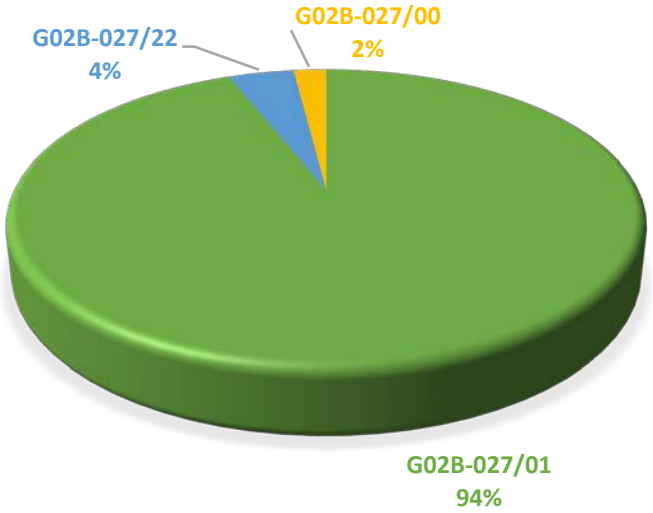
G08G-Subclass Distribution



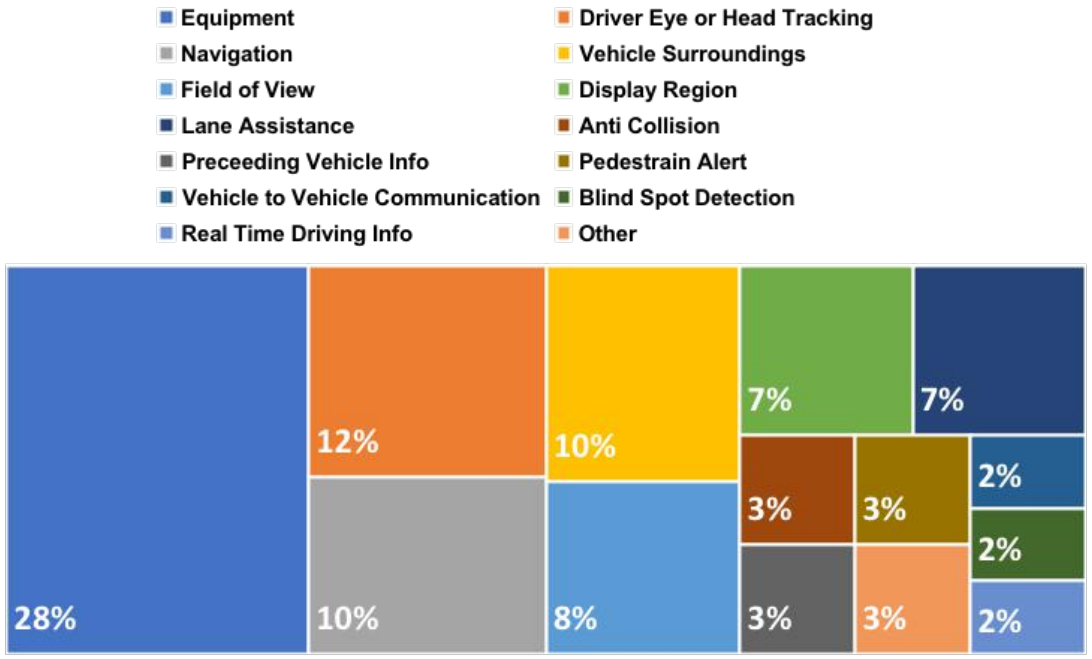
G06F-Subclass Distribution



G02B-Subclass Distribution



Focus of Claimed Inventions



Insight

As evident, maximum number of patent applications are claiming inventions related to ‘Equipment’(28%).

APPENDIX 1: Sources

[1] http://telematicswire.net/automotive-head-up-display-market-to-witness-a-sevenfold-growth-by-2020/

[2] http://news.ihsmarkit.com/press-release/design-supply-chain/automotive-head-display-market-goes-high-gear

[3]https://www.embitel.com/blog/embedded-blog/ces-2017-automotive-spotlight-augmented-reality-ar-based-heads-up-display-hud

[4] http://continental-head-up-display.com/ar-hud/#arhudtechnology

[5] https://www.photonics.com/a58298/HUD_Systems_Augmented_Reality_Is_Coming_to_Your

[6]https://e2e.ti.com/blogs_/b/enlightened/archive/2017/01/05/driving-the-future-of-head-up-display-hud-with-augmented-reality-ar

APPENDIX 2: IPC Sub-class Definitions

IPC SUB-CLASS	DEFINITIONS
B60W 050/14	➢ Warning or informing the driver when the movement of the vehicle will be changed momentarily, e.g. adding a slight yaw rate, momentary deceleration ➢ Informing the driver that the drive control mode will change, e.g. from comfort mode to performance mode. ➢ Assistance systems for warning the driver, e.g. warning the driver if approaching speed at a stopping location will be too high.
B60W 040/02	➢ The estimation or calculation of non-direct measurable parameters related to vehicle drive control and not used for a particular sub-unit, e.g. by using mathematic models for estimation of the parameters.
B60W 030/16	➢ Control of distance between vehicles, e.g. keeping a distance to preceding vehicle
B60W 050/08	➢ All optical viewing arrangements which are not structurally restricted to the vehicular categories fully covered by subclasses provided for rail vehicles, waterborne vessels, aircraft, space vehicles, handcarts, cycles, animal-drawn vehicles, or sledges.
B60W 030/08	➢ Control systems for predicting coming or possible collisions or taking measures to prevent or weaken the impact of a collision.
B60W 030/12	➢ Lane keeping

Source: Espacenet

Continue…

IPC SUB-CLASS	DEFINITIONS
B60K 037/06	➢ The adaptation of input devices for instruments in a vehicle dashboard. The subclass is in particular directed to how the input is generated mechanically or electronically, the input however must be employed to control a vehicle related function (e.g. air condition).
B60K 035/00	➢ Arrangements of instruments for and aspects of display of information in a vehicle.
B60R 001/00	➢ Interfaces between driver and control system not for a single or particular sub-unit with interaction, i.e. communications or actions with a feedback loop between the driver and the control system. The interaction can be a tactile feedback to the driver, e.g. vibrations of the steering wheel.
B60R 016/02	➢ Electric constitutive elements
B60R 011/04	➢ Mounting of cameras operative during drive; Arrangement of controls thereof relative to the vehicle
G06T 19/00	➢ Annotating or labelling of 3D models with text, markers ➢ Dimensioning and tolerancing of 3D models, e.g. display of dimension information for each part ➢ Display of 3D models as an exploded view drawing
G06T 015/00	3D [Three Dimensional] Image Rendering

Continue…

IPC SUB-CLASS	DEFINITIONS
G06T 019/20	➢ Editing of 3D images, e.g. changing shapes or colours, aligning objects or positioning parts
G06T 001/00	➢ General purpose image data processing systems and methods
G01C 021/36	➢ Input/output arrangements of navigation systems; (input arrangements for transferring data to be processed into a form capable of being handled by the computer, and output arrangements for transferring data from processing unit to output unit, e.g. interface arrangements
G01C 021/26	➢ Navigation devices, systems and methods
G01C 021/34	➢ Route searching; Route guidance
G08G 001/969	➢ Having a display in the form of a map
G08G 001/16	➢ Stand-alone systems, like for example distance regulating systems or parking. Anti-collision when a real danger exists ➢ Collision with another vehicle or an obstacle
G08G 001/962	➢ Having an indicator mounted inside the vehicle, e.g. giving voice messages
G08G 001/967	➢ Systems involving transmission of highway information, e.g. weather, speed limits

Continue…

IPC SUB-CLASS	DEFINITIONS
G06F 007/00	➢ Methods or arrangements for processing data by operating upon the order or content of the data handled
G06F 003/481	➢ Interaction techniques based on specific properties of the displayed interaction object or a metaphor-based environment, e.g. interaction with desktop elements like windows or icons, or assisted by a cursor's changing behaviour or appearance
G06F 003/14	➢ Digital output to display device
G06F 003/01	➢ Input arrangements, or combined input and output arrangements, for interaction between user and computer. ➢ Particularly, said input arrangements include those based on the interaction with the human body, e.g. ➢ Gloves for hand or finger tracking; ➢ Eye or head trackers; ➢ Devices using bioelectric signals, e.g. detecting nervous activity; ➢ Arrangements for providing computer generated force feedback in input devices.
G02B-027/00	➢ Other optical systems, for example, head-up displays, head-mounted displays, beam-shaping systems, beam-splitting or combining systems, systems for producing stereoscopic or three-dimensional effects, polarising systems, diffraction systems

Continue…

IPC SUB-CLASS	DEFINITIONS
G02B-027/01	Devices for superimposing a synthetic image on a background scene by projection of a synthetic image on a background scene on a partially transparent surface: ➢ head mounted, e.g. pilot helmets ➢ non head mounted, e.g. windscreen of a car ➢ optical features ➢ mechanical features ➢ display position adjusting means not related to the information which is to be displayed ➢ sight systems
G02B-027/22	➢ Producing stereoscopic or other three dimensional effects

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