SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A+' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

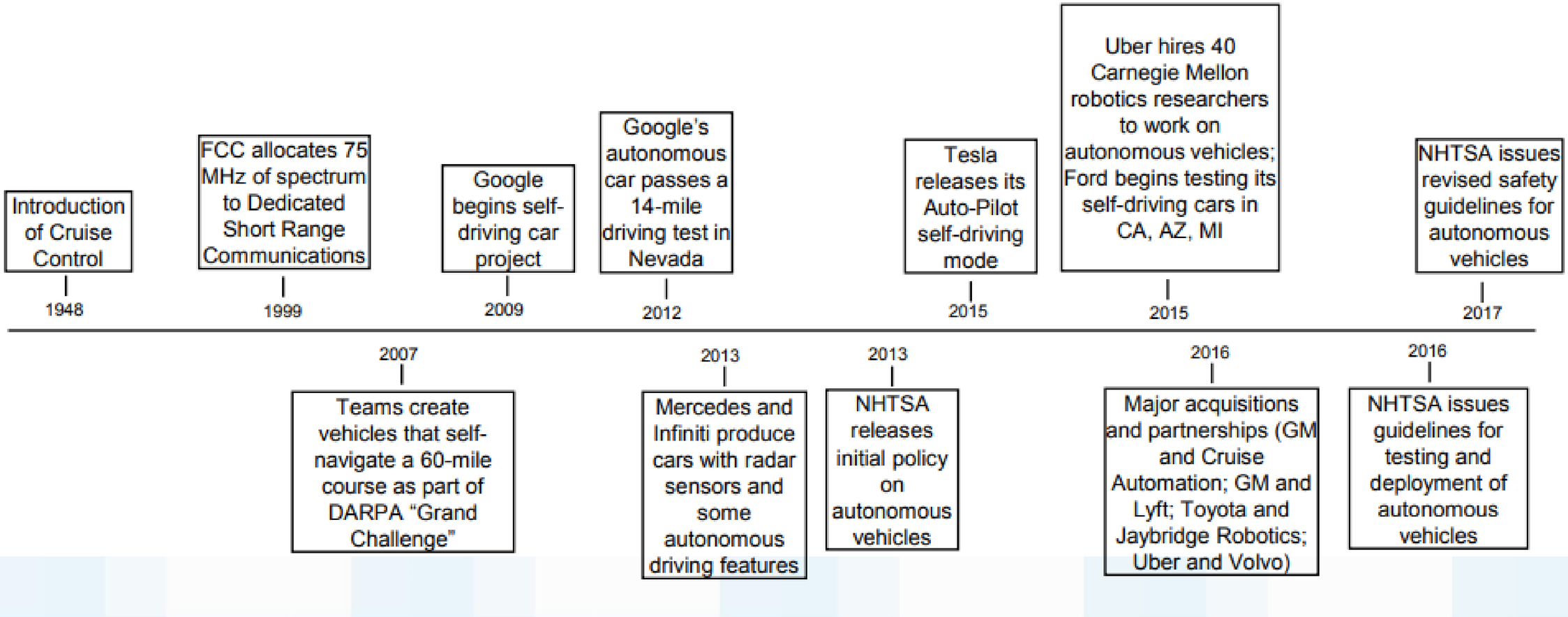
DEPARTMENT OF AUTOMOBILE ENGINEERING

19AUE402 – Intelligent Vehicle Technology

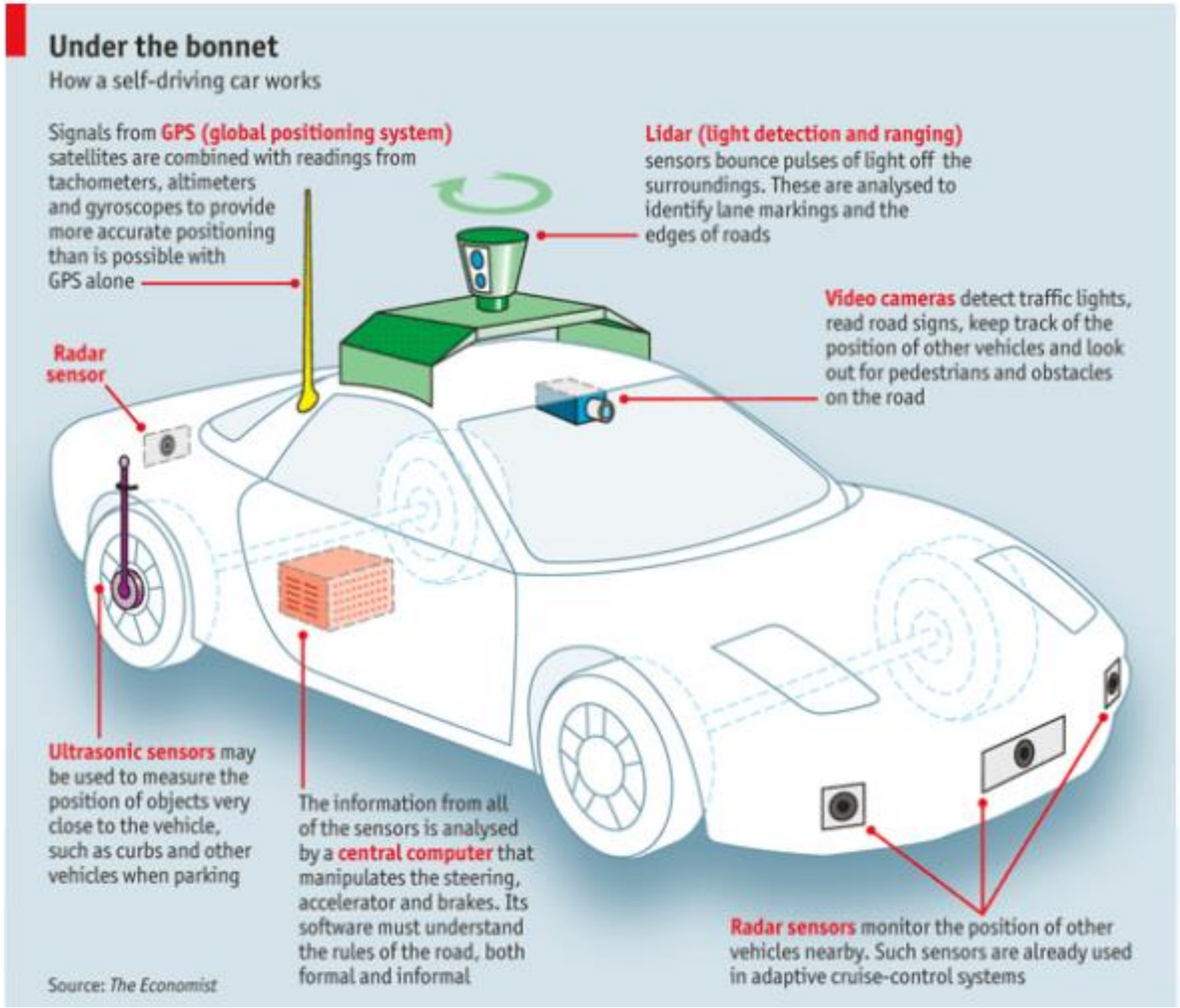
IV YEAR / VII SEM

UNIT – 1 Introduction

History of Autonomous Vehicles

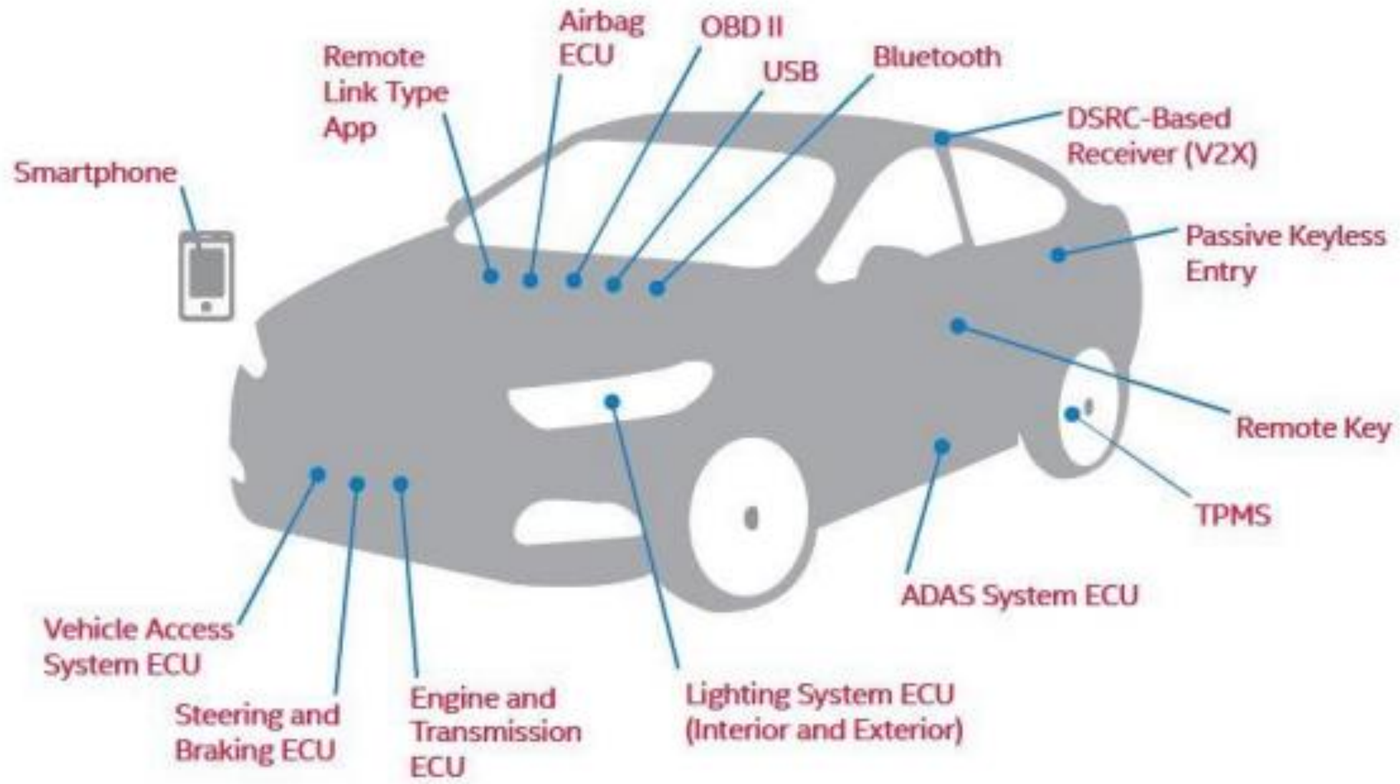


0	1	2	3	4	5
No Automation	**Driver Assistance**	**Partial Automation**	**Conditional Automation**	**High Automation**	**Full Automation**
Zero autonomy; the driver performs all driving tasks.	Vehicle is controlled by the driver, but some driving assist features may be included in the vehicle design.	Vehicle has combined automated functions, like acceleration and steering, but the driver must remain engaged with the driving task and monitor the environment at all times.	Driver is a necessity, but is not required to monitor the environment. The driver must be ready to take control of the vehicle at all times with notice.	The vehicle is capable of performing all driving functions under certain conditions. The driver may have the option to control the vehicle.	The vehicle is capable of performing all driving functions under all conditions. The driver may have the option to control the vehicle.

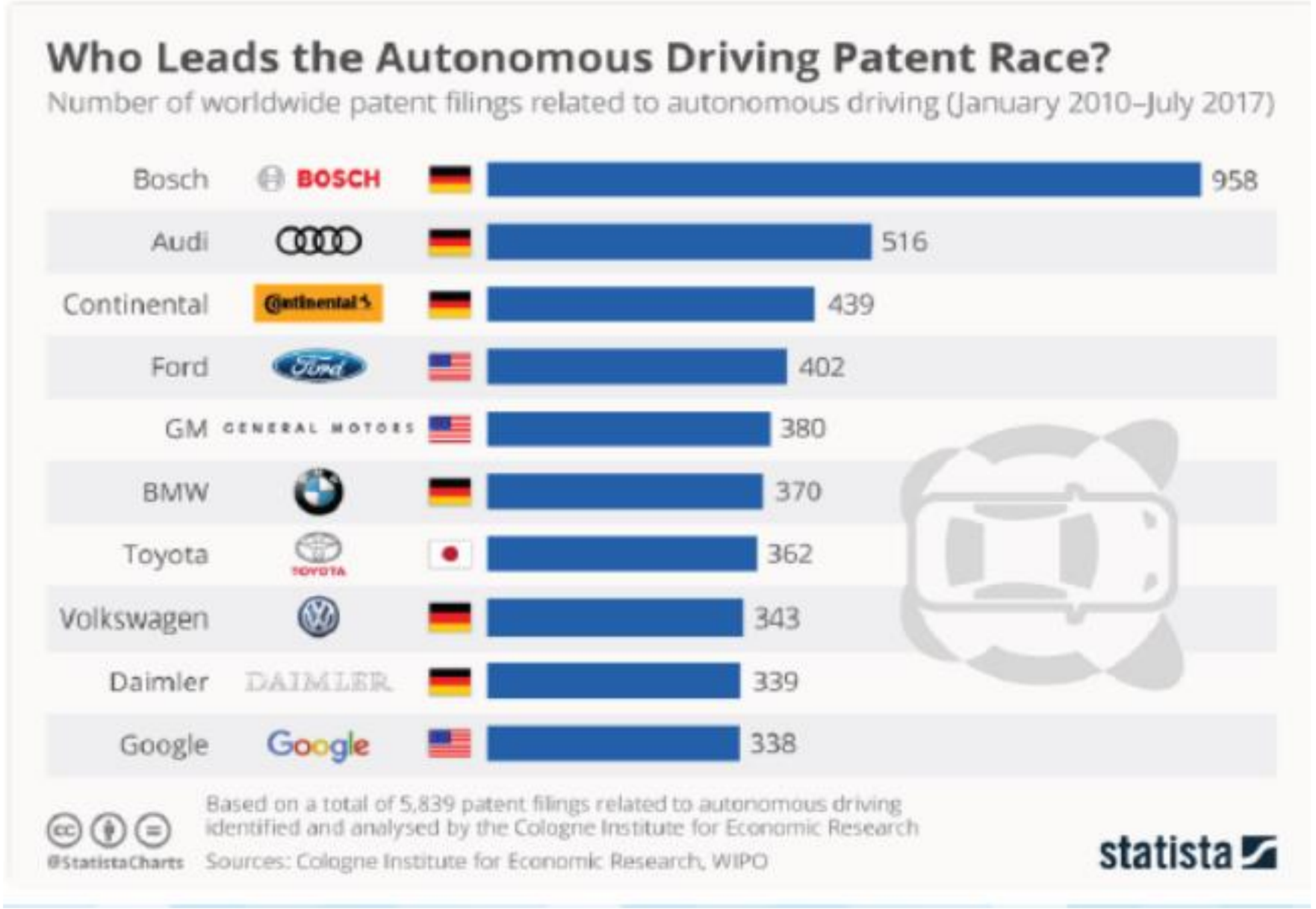


- **Global Positioning System (GPS)**
- **Light Detection and Ranging (LIDAR)**
- **Cameras (Video)**
- **Ultrasonic Sensors**
- **Central Computer**
- **Radar Sensors**
- **Dedicated Short-Range Communications-Based Receiver (not pictured)**

- **Cameras –** Provide real-time obstacle detection to facilitate lane departure and track roadway information (like road signs).
- **Radar –** Radio waves detect short & long-range depth.
- **LIDAR –** Measures distance by illuminating target with pulsed laser light and measuring reflected pulses with sensors to create 3-D map of area.
- **GPS –** Triangulates position of car using satellites. Current GPS technology is limited to a certain distance. Advanced GPS is in development.
- **Ultrasonic Sensors –** Uses high-frequency sound waves and bounce-back to calculate distance. Best in close range.
- **Central Computer –** "Brain" of the vehicle. Receives information from various components and helps direct vehicle overall.
- **DRSC** - Based Receiver – Communications device permitting vehicle to communicate with other vehicles (V2V) using DSRC, a wireless communication standard that enables reliable data transmission in active safety applications. NHTSA has promoted the use of DSRC.



- Electrical Control Units (ECUs)
- Airbag, Advanced Driver Assistant System, Engine, Steering & Brakes, etc.
- On-Board Diagnostics (OBD) II Diagnostic Port
- Dedicated Short-Range Communications-Based Receiver
- USB Ports
- Passive Keyless Entry/ Remote Key
- Remote Link Type App
- Tire Pressure Monitoring System (TPMS)


Who Leads the Autonomous Driving Patent Race?
Number of worldwide patent filings related to autonomous driving (January 2010–July 2017)
Bosch 958
Audi 516
Continental 439
Ford 402
GM 380
BMW 370
Toyota 362
Volkswagen 343
Daimler 339
Google 338
Based on a total of 5,839 patent filings related to autonomous driving identified and analysed by the Cologne Institute for Economic Research
@StatistaCharts
Sources: Cologne Institute for Economic Research, WIPO
statista

Ranking	Company
1	Toyota
2	Robert Bosch GmbH
3	Denso Corp.
4	Hyundai Motor Corp.
5	General Motors

- Toyota is the global leader in the number of autonomous vehicle patents with more than 1,400 patents
- Google is the tech company with the most autonomous vehicle patents, but ranks 26th when compared to all companies with autonomous vehicle patents

Source: https://www.reuters.com/article/us-tech-ces-autos/automakers-not-silicon-valley-lead-indriverless-car-patents-study-idUSKBN0UJ1UD20160105; The 2016 State of Self-Driving Innovation, Thomson Reuters.

Autonomous Driving: Navigating a vehicle without human input from passengers using sensory (LIDAR), control, and navigation equipment that responds to the environment when traveling.

Driver Assistance: Enhances vehicle systems for safety and improved driving when the driver is in control. Technology includes blind-spot detection, pedestrian detection, lane-departure warnings, intelligent braking, traffic-sign recognition, automatic braking, and adaptive cruise control.

Telematics: Includes telecommunications, vehicular technologies, road transportation, road safety, electrical engineering (sensors, instrumentation, wireless communications, etc.), computer science (multimedia, Internet, etc.), GPS technology, DSRC, V2V, and V2I.

- **Artificial Intelligence (AI)** – In order for the AV to operate in a full range of environments with millions of changing aspects that will need to be accounted for, it will require AI, which will allow the base level software to be developed and tested with a self-learning capability.
- **GPS** – These global positioning systems will be a critical link for AV to determine their location as they move.
- **Dedicated short range communications (DSRC)** – The ability for vehicles to communicate with each other ("vehicle-to-vehicle" or "V2V") and infrastructure ("vehicle-to-infrastructure" or "V2I").
- **LIDAR** – LIDAR is a radar system that emits a laser in a pattern similar to a rotating radar, only in more discrete and densely-spaced increments. The reflected laser light is used to provide the AV information on the distance for each discrete laser emission.

Thank You