THE BEST

No.5

February 2024

IN THE ENGINEERING WORLD

Introducing Best companies and startups in the field of autonomous vehicles

ROBOTAXI

AVIS
Engine

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AVIS Engine

AVIS Researchers Association

آیتی TAKANEH مجله علم و فناوری

ZOOX   cruise   Yandex   peyk   Motional

nuro   WAYMO   ROBOTIS   Aurora   ARGO AI

STARSHIP   autoX   amazon   DiDi

Introducing Best companies and startups in the field of autonomous vehicles

Waymo

Logo	Headquarters
	Mountain View, California, U.S.

Waymo

Introduction

Waymo LLC, formerly known as the Google Self-Driving Car Project, is an American autonomous driving technology company headquartered in Mountain View, California. It is a subsidiary of Alphabet Inc, the parent company of Google.

The company traces its origins to the Stanford Racing Team, which competed in the 2005 and 2007 DARPA Grand Challenges.[1] Google's development of self-driving technology began in January 2009, where it was led by Sebastian Thrun, the former director of the Stanford Artificial Intelligence Laboratory (SAIL) and Anthony Levandowski, founder of 510 Systems and Anthony's Robots. After almost two years of road testing with seven vehicles, the New York Times revealed its existence in October 2010.

History

Google's development of self-driving technology began on January 17, 2009, at Google X lab, run by co-founder Sergey Brin. The project was launched at Google by Sebastian Thrun, the former director of the Stanford Artificial Intelligence Laboratory (SAIL) and Anthony Levandowski, founder of 510 Systems and Anthony's Robots.

The initial software code and AI design of the effort started before the team worked at Google, when Thrun and 15 engineers, including Dmitri Dolgov, Mike Montemerlo, Hendrik Dahlkamp, Sven Strohband, and David Stavens, built Stanley and Junior, Stanford's entries in the 2005 and 2007 DARPA Challenges. Later, aspects of this technology were used in a digital mapping project for SAIL called VueTool. In 2007, Google acqui-hired the entire VueTool team to help advance Google's Street View technology.

Waymo

As part of Street View development, 100 Toyota Priuses were outfitted with Topcon digital mapping hardware developed by 510 Systems.
In 2008, the Street View team launched project Ground Truth, to create accurate road maps by extracting data from satellites and street views.

ZOOX

Logo	Headquarters
ZOOX	Foster City, California, United States

ZOOX

Introduction

Zoox, Inc. is a subsidiary of Amazon developing autonomous vehicles that provide mobility as a service. It is headquartered in Foster City, California and has offices of operations in the San Francisco Bay Area and Seattle, Washington. Zoox sits in the Amazon Devices & Services organization alongside other Amazon units like Amazon Lab126, Amazon Alexa, and Kuiper Systems.

History

Zoox was founded in 2014 by Australian artist-designer Tim Kentley-Klay and Jesse Levinson, son of Apple Inc. chairman Arthur D. Levinson, who was developing self-driving technology at Stanford University. The name "Zoox" is a reference to Zooxanthellae, a marine organism that, like the Zoox robo-taxi, depends on renewable energy and is able to maintain a symbiotic relationship with organisms in its surrounding habitat.

In January 2019, Zoox appointed a new CEO, Aicha Evans, who was previously the Chief Strategy Officer at Intel. On June 26, 2020, Amazon and Zoox signed a definitive merger agreement, under which Amazon acquired Zoox as a wholly-owned subsidiary for over $1.2 billion. As is the case with other Amazon subsidiaries like Amazon Web Services, Zoox has no independent board of directors, but operates as a separate legal entity with its own governance structure. Zoox sits within the Amazon Devices & Services organization with Evans reporting into Amazon Senior Vice President, Dave Limp.

Cruise

Logo	Headquarters
cruise	San Francisco, California, U.S.

Cruise

Introduction

Cruise LLC is an American self-driving car company headquartered in San Francisco, California. Founded in 2013 by Kyle Vogt and Dan Kan, Cruise tests and develops autonomous car technology. The company is a largely autonomous subsidiary of General Motors.

History

Cruise initially focused on developing direct-to-consumer kits to retrofit vehicles with limited self-driving capabilities. The earlier generation of Cruise technology, RP-1, offered an autonomous on-demand feature available for the Audi A4 or S4 (2012 or later). The $10,000 kit is intended to eventually retrofit all vehicles into a highway autopilot system. Ultimately, Cruise determined that the greater challenge lay in conquering city driving. In January 2014, the company decided to abandon the RP-1 and produce a fully autonomous vehicle using the Nissan Leaf. In 2015, Cruise changed its strategy and began writing software to be used for fully self-driving vehicles. The brand philosophy urges car owners to engage in shared ownership instead of individual ownership, in order to reduce environmental damage, the number of accidents, and congestion in big cities.

Cruise received a permit to test self-driving vehicle technology from the California Department of Motor Vehicles in June 2015. After it successfully graduated from Y Combinator, a startup accelerator that mentors up-and-coming entrepreneurs, Cruise was acquired by General Motors in March 2016. The amount was undisclosed, and reports have estimated the number from "north of $500 million", to $580 million to over $1 billion. Cruise forms the core of GM's self-driving efforts.

Aurora Innovation

Logo	Headquarters
Aurora	Pittsburgh, PA and Mountain View, CA, U.S.

Aurora Innovation

Introduction

Aurora Innovation, Inc., doing business as Aurora, is a self-driving vehicle technology company based in Pittsburgh, Pennsylvania. Aurora has developed the Aurora Driver, a computer system that can be integrated into cars for autonomous driving.

Aurora was co-founded by Chris Urmson, the former chief technology officer of Google/Alphabet Inc.'s self-driving team, which became known as Waymo, as well as by Sterling Anderson, former head of Tesla Autopilot, and Drew Bagnell, former head of Uber's autonomy and perception team.

Aurora tests its vehicles in the San Francisco Bay Area, Pittsburgh, and Dallas. In addition to its headquarters in Pittsburgh and Mountain View, the company also has offices in San Francisco, Bozeman, Montana, and Texas.

History

Aurora was founded in 2017 by Chris Urmson, the former chief technology officer of Google/Alphabet Inc.'s self-driving team, which became known as Waymo. Previously, Urmson was a member of Carnegie Mellon's Red Team, which competed in DARPA's Grand Challenges for autonomous vehicles. His two co-founders are Sterling Anderson, former head of Tesla Autopilot, and Drew Bagnell, former head of Uber's autonomy and perception team.

In January 2018, Aurora signed deals with Volkswagen and Hyundai to develop self-driving software for commercial vehicles. Also in January 2018, at CES 2018, Nvidia partnered with Aurora to provide hardware for Aurora's self-driving systems.

In October 2018, Aurora became the first self-driving vehicle company authorized to test its vehicles in Pennsylvania.
In January 2019, the company raised financing at a $2 billion valuation.

Argo AI

Logo	Headquarters
	Pittsburgh, Pennsylvania, U.S.

Argo AI

Introduction

Argo AI was an autonomous driving technology company headquartered in Pittsburgh, Pennsylvania. The company was co-founded in 2016 by Bryan Salesky and Peter Rander, veterans of the Google and Uber automated driving programs. Argo AI was an independent company that built software, hardware, maps, and cloud-support infrastructure to power self-driving vehicles.

Argo was mostly backed by Ford Motor Co. (2017) and the Volkswagen Group (2020).

In October 2022 it was announced by Ford that the company would be disbanded and some employees would be split between VW and Ford. Argo's technology will be salvaged and further developed in-house by Ford and VW.

Ford stated their intent to change the focus of development from Level 4 autonomous driving to Level 3 and Level 2+.

History

Argo AI was co-founded in November 2016 by roboticists Bryan Salesky, CEO of the company, and company president Peter Rander. As of July 2020, the company employed over 1000 employees with offices in Pittsburgh, Detroit, Palo Alto, Cranbury, NJ and Munich, Germany. In June 2020, Argo was valued at $7.25 billion.

Motional

Logo	Headquarters
	Boston, Massachusetts, United States

Motional

Introduction

Motional is an American autonomous vehicle company founded in March 2020 as a joint venture between automaker Hyundai Motor Group and auto supplier Aptiv. Headquartered in Boston, Massachusetts, Motional also maintains operations in Pittsburgh, Singapore, Las Vegas, and Los Angeles. Motional began testing its newest generation of vehicles in Las Vegas, Nevada, in February 2021, and also operates vehicles in Pittsburgh and Santa Monica, California.

History

- 2013 - nuTonomy and Ottomatika, Inc. are established as spin-offs at Massachusetts Institute of Technology and Carnegie Mellon University.
- 2015 - Delphi acquired Ottomatika
- 2015 - Delphi demonstrates what they claim to be America's first fully autonomous transcontinental crossing.
- 2016 - nuTonomy trial operated the world's first autonomous taxi in Singapore.
- 2017 - nuTonomy begins autonomous driving in Boston
- 2017 - Delphi acquired nuTonomy
- 2017 - Delphi renamed as Aptiv
- 2018 - Aptiv acquired NuTonomy and Ottomatika and formed an Autonomous Driving Team
- 2018 - First public robotaxi service tests in Las Vegas in collaboration with Lyft, with 50,000 rides in the first year
- 2019 - Aptiv & Hyundai Motor Group officially announce an autonomous driving joint venture
- 2020 - The establishment of Motional, an autonomous driving technology development joint venture
- 2021 - Autonomous (SAE level 4) vehicle test drive successful on normal roads

Motional

- 2022 - Motional and Lyft's public service is launched in Las Vegas using autonomous, all-electric Hyundai Ioniq 5 vehicles with a safety driver
- 2022 - Motional and Lyft announced the planned launch of a fully driverless ride-hail service in Los Angeles
- Karl Iagnemma, founder of NuTonomy, was CEO of Motional as of 2023.

Nuro
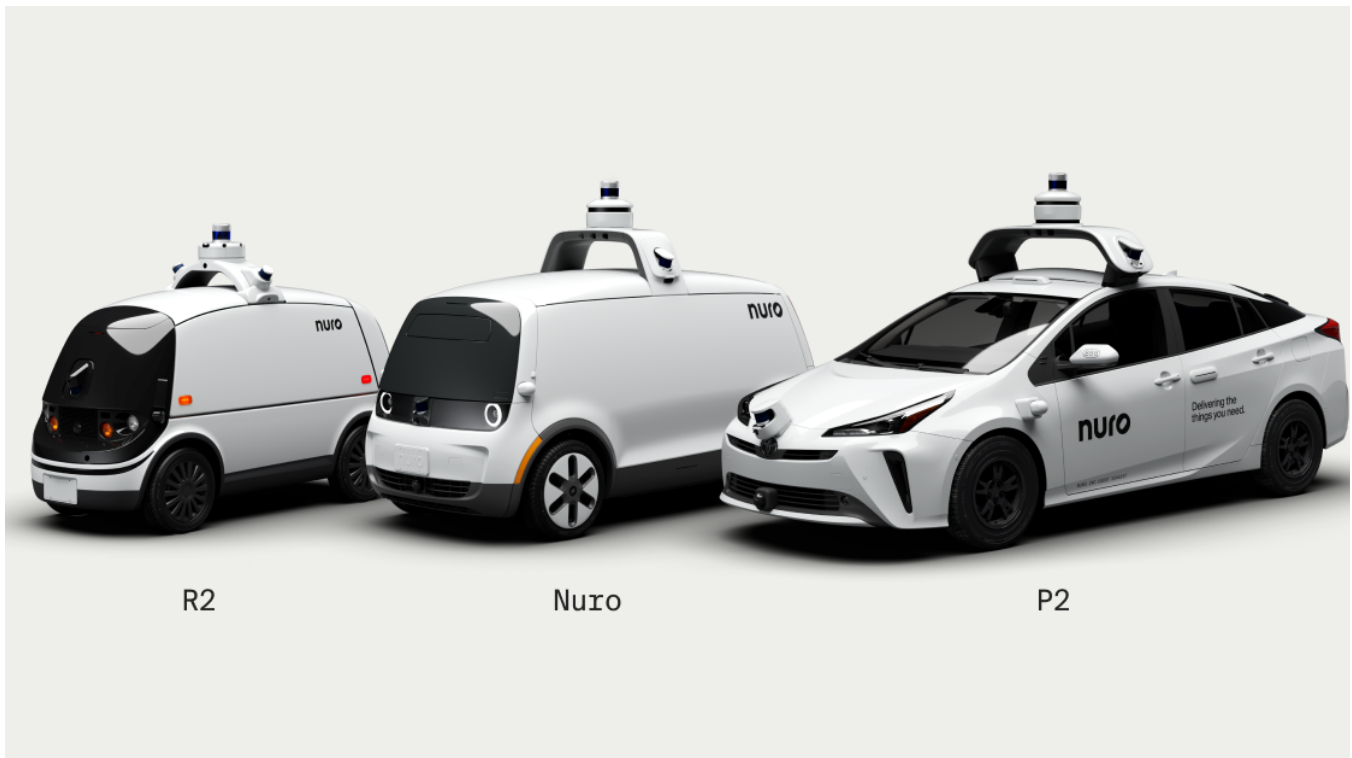
R2   Nuro   P2

Logo	Headquarters
nuro	Mountain View, California

Nuro

Introduction

Nuro, Inc. is an American robotics company based in Mountain View, California. Founded by Jiajun Zhu and Dave Ferguson, Nuro develops autonomous delivery vehicles and is the first company to receive an autonomous exemption from the National Highway Traffic Safety Administration.

History

The company was founded by engineers of Google's self driving car project, Waymo. Zhu served as the principal software engineer and Ferguson joined in 2011 as the principal machine learning engineer. Zhu and Ferguson left Waymo in 2016 and founded Nuro that September.

Nuro brought its robotic delivery vehicles to market in January 2018 with $92 million in funding from Greylock Partners and Gaorong Capital.

In February 2019 Nuro raised $940 million from SoftBank Group, which valued the company at $2.7 billion. Nuro said it would use the funds to expand its delivery service to new areas, add new partners, expand its fleet and grow its business. In September 2019, the company was ranked No.10 on LinkedIn's Top 50 Startups List for 2019.

Amazon Scout

Logo	Headquarters
amazon	Seattle, Washington and Arlington County, Virginia, US

Amazon Scout

Introduction

Amazon Scout is a 6 wheeled delivery robot used to deliver packages for multinational company Amazon. Amazon Scout originally debuted on January 23, 2019, delivering packages to Amazon customers in Snohomish County, Washington. Amazon scouts move on sidewalks, at a walking pace. In August, 2019, the robots started delivering packages to customers Irvine, California on a test basis, with human monitors.

The package is stored inside of the robot, and driven to the customer. Amazon acquired the robotics company Dispatch to build the robot. Amazon cancelled Amazon Scout in January 2023.

Starship Technologies

Logo	Headquarters
STARSHIP	San Francisco, United States

Starship Technologies

Introduction

Starship Technologies is an Estonian company developing autonomous delivery vehicles. The company is headquartered in San Francisco, California, with engineering operations in Tallinn, Estonia, and Helsinki, Finland. Starship also has offices in London, UK, Germany, Washington, DC, US, and Mountain View, California, US.
In January and February 2022, Starship raised nearly US$100 million in funding from the European Investment Bank and venture investors, which is expected to be put towards research and development and 1,700 additional robots to the company's fleet. The company has raised approximately $202 million since being founded in 2014.

History

Starship Technologies was founded by Skype co-founders Janus Friis and Ahti Heinla. Initially, it was called Project Echo. A core team of the company became the team Kuukulgur, which led by Ahti Heinla had participated in NASA Centennial Challenge by building experimental sample retrieval robots. Starship Technologies OÜ was registered on 11 June 2014 in Tallinn, Estonia.

Starship Technologies, Inc., a Delaware corporation, was registered in San Francisco, United States, on 28 September 2016.

Starship Technologies launched pilot services in 2016, in the US and the UK among other countries, with commercial services launched in 2017. In April 2018, Starship launched its autonomous delivery service in Milton Keynes, England, in partnership with Co-op and Tesco. In March 2020, Starship became the first robot delivery service to operate in a British town center with the rollout of its service in Central Milton Keynes.

By November 2020, said Starship, Milton Keynes had the 'world's largest autonomous robot fleet' By March 2023 Starship was delivering in seven British cities.

Starship Technologies

In January 2019, Starship partnered with Sodexo to launch robot food delivery services at George Mason University in Virginia, US. With a fleet of 25 robots at launch, this was the largest implementation of autonomous robot food delivery services on a university campus at that time. In 2019, it expanded its services to six other US universities. and in 2020 to two more.

In March 2020, following the start of the COVID-19 pandemic, Starship made many redundancies. However, half a year later, and after the US universities reopened, it rehired many of the staff.

Robotis

Logo	Headquarters
ROBOTIS	South Korea

Robotis

Introduction

ROBOTIS is a leading developer of smart servos, industrial actuators, manipulators, open-source humanoid platforms, and educational robotic kits. At ROBOTIS, we strive to develop solutions for the robotic needs of various groups, ranging from K-16, to research institutions and related industries.

Yandex
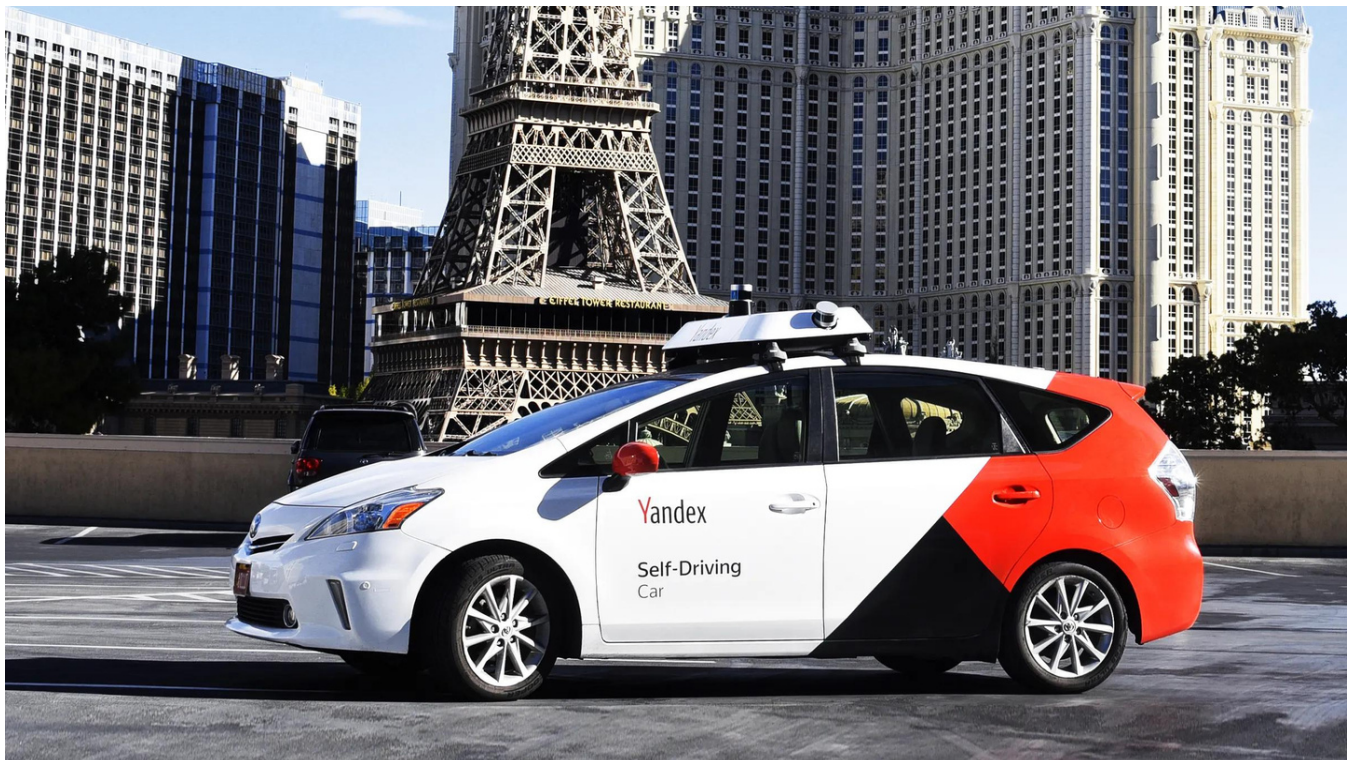
Logo	Headquarters
	Moscow, Russia

Yandex

Introduction

Yandex self-driving car (Yandex Self-Driving Group) is an autonomous car project of the Russian-based technology company Yandex. The first driverless prototype launched in May 2017. As of 2018, functional service was launched in Russia with prototypes also being tested in Israel and the United States. In 2019, Yandex revealed autonomous delivery robots based on the same technology stack as the company's self-driving cars.Since 2020, autonomous robots have been delivering food, groceries and parcels in Russia and the United States. In 2020, the self-driving project was spun-off into a standalone company under the name of Yandex Self-Driving Group (Yandex SDG)

History

In June 2017, Yandex.Taxi released a video demonstrating its driverless car technology. The prototype vehicle was a heavily modified Toyota Prius+ hybrid wagon/compact MPV equipped with three LiDAR optical distance sensors by Velodyne, six radar units, and six cameras and a GNSS sensor for navigation, with Intel CPUs and NVIDIA GPUs using the GNU operating system with the Linux kernel.

In November 2017, the results of a winter test were presented. The car drove successfully along snowy roads, despite the increased difficulties presented by the snow. The vehicle covered 300 km on a closed track.

AutoX

Logo	Headquarters
	San Jose, California, United States

AutoX

Introduction

AutoX is a leading self-driving car company in the world. AutoX's self-driving car is capable of handling the most challenging and dynamic traffic scenarios in urban cities around the world. AutoX obtained the world's second driverless RoboTaxi permit from California. AutoX was the first company in Shenzhen and Shanghai to operate a fully driverless RoboTaxi service on public roads without any safety driver, covering the world's largest driverless area.

DiDi Autonomous Driving

Logo	Headquarters
DiDi	Beijing, China

DiDi Autonomous Driving

Introduction

DiDi's autonomous driving unit was set up in 2016 and was committed to delivering world's leading Level 4 autonomous driving ("AD") technologies, aiming to make transportation safer and more efficient. In August 2019, this unit was upgraded to an independent company, DiDi Autonomous Driving, focusing on advanced AD technology research and development, product application and other expanded businesses. Up to now, DiDi Autonomous Driving have acquired public road testing licences in Beijing, Shanghai, Suzhou, Hefei, Guangzhou and California, along with one of the first Intelligent Connected Vehicle Demostration Application License in China that issued by Shanghai.

We believe that the deployment of AD technology into shared-mobility fleet will create great social value. DiDi's advanced technologies, massive data, rich experience along with complete ecosystem in the mobility field will equip DiDi Autonomous Driving to build and operate world's leading autonomous fleets.

Peyk

Logo	Headquarters
peyk	London, England

Peyk

Introduction

Peyk is a London based peer to peer delivery platform that has been founded in 2018. Late 2021, after the impacts of COVID-19 and Brexit, the UK faced an employment crisis where many delivery services closed down but Peyk decided to expand its product portfolio into designing and manufacturing autonomous delivery robots.

Autonomous Vehicle Tech Stack Review

Waymo

Waymo, a subsidiary of Alphabet (Google's parent company), started research on autonomous vehicles in 2009. In October 2020, it became the first robotaxi service to offer service to the public without safety drivers in the vehicle. Waymo's 5th-generation driver is a combination of hardware, software, and compute designed to navigate complex driving environments. It relies on a comprehensive sensor suite, including high-resolution 360-degree LiDAR with a 300-me ter range, cameras with overlapping fields of view for detailed imaging, and a newly designed imaging radar system that provides high resolution even in adverse weather conditions.

The technology was developed from over 20 million self-driven miles and 10 billion simulated miles.

In the last three years, Waymo has focused on scalable production, reducing costs while increasing sensor capabilities. Since 2018, Waymo has been working with Jaguar Land Rover to create the world's first premium electric fully self-driving vehicle. Its latest iteration is currently being tested on public roads in the US.

Camera Array and Coverage

Currently, Waymo's enhanced vision system integrates high-dynamic range cameras with exceptional thermal stability to deliver crisp, detailed images across extreme automotive temperature conditions.

The long range and 360-degree cameras extend vision capabilities beyond 500 meters, sharpening the detection of critical elements like pedestrians and road signs. Moreover, custom-designed lenses and meticulous optomechanical construction elevate these cameras beyond current standards. In synergy with perimeter LiDAR sensors, the pe rimeter vision system grants addition al contextual data, improving object identification. The peripheral vision system mitigates blind spots, ensuring safer maneu vering around large vehicles. This network of cameras empowers the Waymo Driver with unprecedented decision-making clarity and speed.

LiDAR

The 5th-generation Waymo Driver employs a sophisticated overlapping LiDAR system. Its core LiDAR creates a 3D picture of the vehicle's surround ings that can discern the size and dis tance of objects around it. This system is effective over 300 meters, allowing it to identify objects in various light ing conditions, from bright sunlight to moonless nights.

The 360 LiDAR system offers a comprehensive view that can distinguish minute details, such as opening a car door from a block away, aiding in navigating complex city environments. Moreover, it also enables Waymo's trucks to detect road debris from a considerable distance, allowing for timely and safe maneuvering on highways.72 Waymo's perimeter LiDARs, placed at strategic points around the vehicle, afford a wide field of view for detecting proximity objects. This feature is critical for navigating tight spaces in heavy traffic and monitoring potential blind spots caused by the terrain. Altogether, these LiDAR systems represent a significant upgrade from previous iterations, improving the Waymo Driver's ability to handle more challenging driving scenarios.

RADAR

Waymo's sensor fusion is defined by the integration of LiDAR, camera, and RADAR technologies. LiDAR constructs a 3D outline of objects, while cameras contextualize the vehicle's surroundings. The radar, with its swift velocity measurement, excels in challenging weather, offering a consistent panoramic view. The 5th-generation radar architecture contains an imaging radar system that enhances resolution and range. It is engineered to cover vast distances, such as detecting a distant motorcyclist, providing the Waymo Driver with improved reaction time and ensuring a smoother journey for passengers.

Artificial Intelligence

Within its AVs, Waymo integrates AI for diverse functions, including object detection, lane identification, and obstacle evasion. The company harnesses AI to create an environment mapping and route planning system for its autonomous fleet.75 In addition, Waymo quantifies uncertainty in sensor data using probabilistic methods, enabling event probabilities like pedestrian crossing calculations. Moreover, data augmentation is harnessed to expand training data artificially, diminishing the impact of noise. The company also enhances accuracy by using ensemble learning and training distinct autonomous perception models.

Waymo employs a hybrid strategy, blending deep learning with hand crafted features to enhance their feature extraction process. Their DL models are educated using an extensive dataset collected from their self-driving vehicles, encompassing images, LiDAR, and RADAR data. These models learn to identify vital driv ing-related attributes, such as object shapes, distances, and velocities.
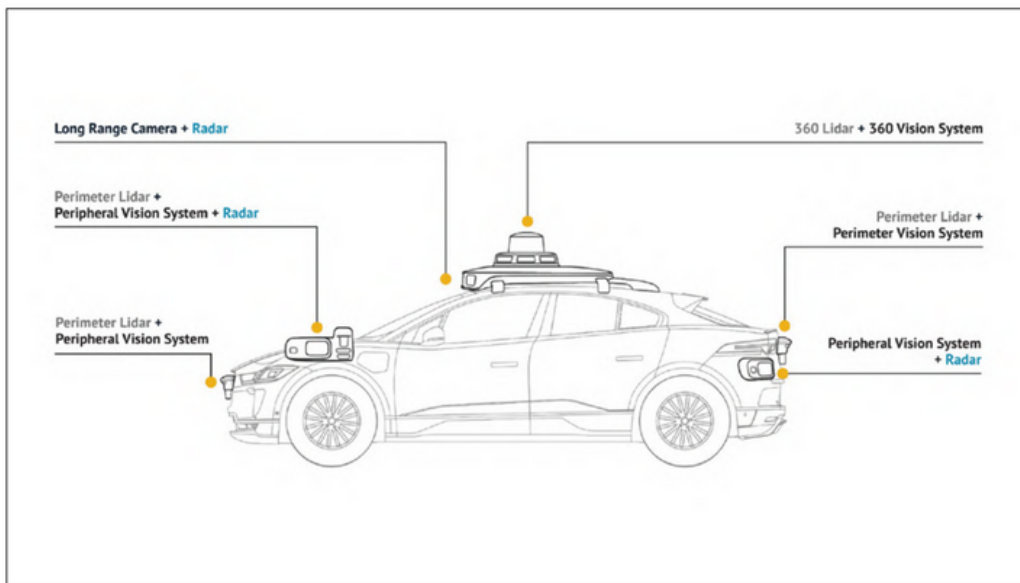
5th-generation Waymo Driver.
Image credit: Waymo

Camera view of Waymo's Jaguar I-PACE vehicle.
Image credit: Waymo

Introduction to AVIS Engine

Introduction to AVIS Engine

The AVIS Engine is a fast and robust autonomous vehicle simulator that satisfies the needs of development and implementation of autonomous vehicles. It enables developers to develop their algorithms and consider a wide range of real-world cases and challenges.

The Simulator is also integrated with python and c++ which allows many developers to work with this simulator. One of the main features of the simulator is that it's fast and also compatible with low-end computers.

We tried our best to build a realistic simulator in any aspect. Such as physics, control and drive, lighting, outdoor design; so it helps developers to get the most accurate results on testing their algorithms on various situations. As the simulator itself is optimized so it provides outputs from sensors and camera in real-time and with really low latency. Sensors such as LIDAR, RADAR, GPS are going to be added to this simulator in the future to allow developers to work on perception, path planning, and localization.
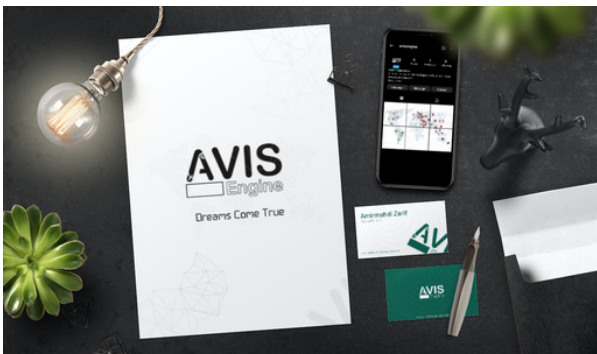
AVIS Researchers Association Membership Certificate

Special membership certificate for researchers in the field of autonomous vehicles

What is AVIS Researchers Association Membership Certificate?

AVIS Engine Group has established an association under the title "AVIS Researchers Association" to provide services and networking among researchers in the field of robotics and artificial intelligence, especially researchers in the field of autonomous vehicle development. In order to provide better services and create a wide community of AVIS Engine contacts, this association has considered to issue and provide certificates to people who qualify for membership in this association. In the following, we discuss the necessary conditions to receive "AVIS Researchers Association Membership Certificate".

Who Can Apply?

The necessary criteria to obtain AVIS Researchers Association Membership Certificate for Researchers is at least having one item as follows:

- Sending documents related to any activity in the field of development of autonomous vehicles

- Carrying out the project in the platform of AVIS Engine simulators along with sending video and Technical Report of Project (TRP)

- Innovation in project implementation in the AVIS Engine platform

- Participating in events held on the platform of AVIS Engine simulator such as FIRA RoboWorld Cup and presenting a certificate of participation in the competition

Membership certificates are provided based on activities performed at three levels: A, A+, and A++.

AVIS Researchers Association
Membership Certificate

Special membership certificate for researchers in the field of autonomous vehicles

MEMBERSHIP LEVELS

People who are involved in the development of autonomous vehicles; They can receive A-level membership by submitting their resume and documentation of their activity if approved by the association committee.

People who have done a project on the AVIS Engine simulator platform can apply to receive A+ level membership by sending a video of the project done on the AVIS Engine platform and Technical Report of Project (TRP).

People who have innovated in carrying out the project on the platform of AVIS Engine simulator can apply for A++ membership by submitting the project documentation. Also, people who participate in events such as FIRA RoboWorld Cup, which is held on the platform of AVIS Engine simulator, can obtain A++ membership by presenting a certificate of participation in the competition.

AVIS Researchers Association
Membership Certificate

Special membership certificate for researchers in the field of autonomous vehicles

How can I apply for membership?

People must first fill out the initial membership form and register on the AVIS Engine website.

After that, in the next step, they can send their membership request by uploading the documents and entering the relevant information.

The result of the initial review of membership by the association committee will be sent to you by email.

AVIS RESEARCHERS MEMBERSHIP BENEFITS

- Tournament information; exhibitions ; Conferences and festivals that are held around the world in the field of robotics and artificial intelligence will be sent to the members of this association with discounts and special conditions for participation.

- AVIS Engine creates a network between the AVIS Researchers Association Members.

- The possibility of providing certificates to companies; AVIS Engine partner universities and organizations.

- Valid global certificate of membership.

- Members who receive A++ level membership can access new AVIS Engine products before they are available to the public; They have the possibility to test and review the product.

- It is possible to verify the validity of the certificate online on the AVIS Engine website.

Overview of the Best companies and startups in the field of autonomous vehicles

Company Name	logo	Headquarters
Waymo	WAYMO	Mountain View, California, U.S.
ZOOX	ZOOX	Foster City, California, United States
Cruise	cruise	San Francisco, California, U.S.
Aurora Innovation	Aurora	Pittsburgh, PA and Mountain View, CA, U.S.
Argo AI	ARGO AI	Beijing, China
Motional	Motional	Boston, Massachusetts, United States
nuro	nuro	Mountain View, California
Amazon Scout	amazon	Seattle, Washington and Arlington County, Virginia, US
Starship Technologies	STARSHIP	San Francisco, United States
Robotis	ROBOTIS	South Korea

Company Name	logo	Headquarters
Yandex		Moscow, Russia
AutoX		San Jose, California, United States
DiDi Autonomous Driving		Beijing, China
Peyk		London, England

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