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Accelerating intelligence: the AI highway for automotive advancements

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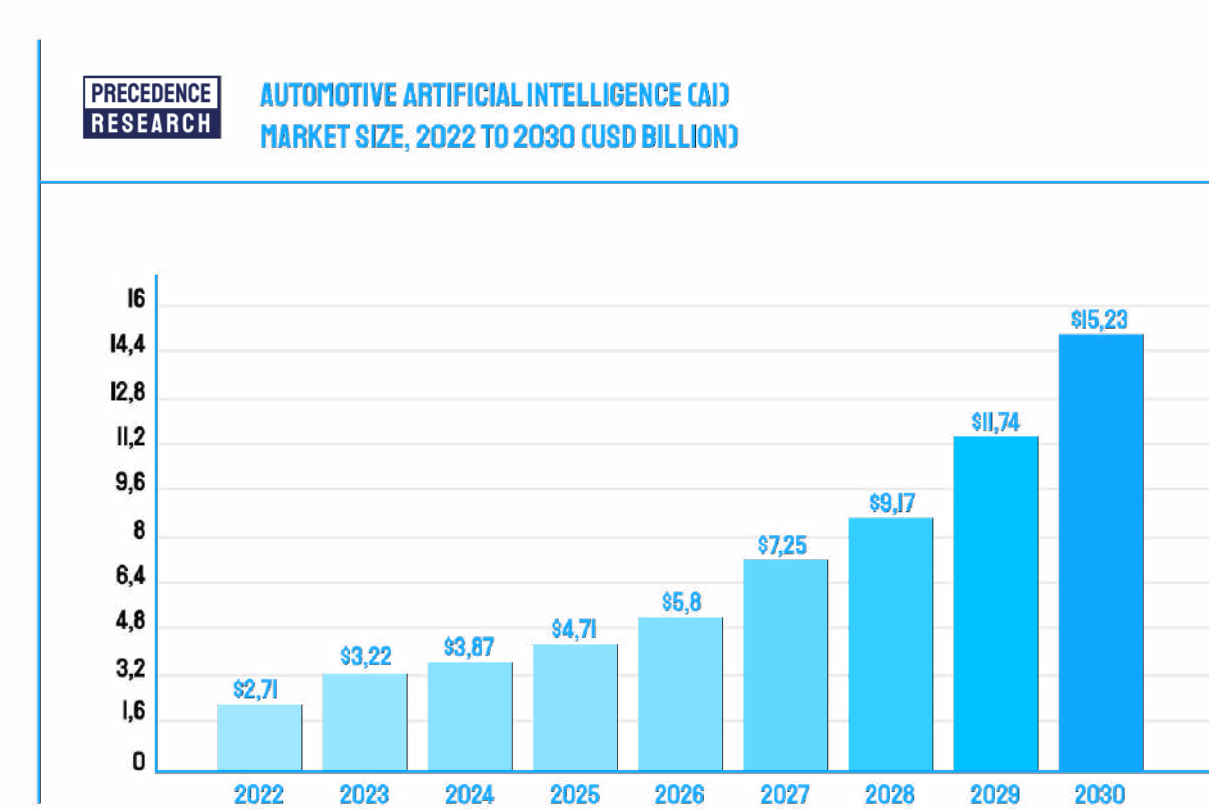
Introduction

The status quo in the automotive industry is undergoing significant changes. Internal combustion engines are actively being replaced by electrified powertrains, and Artificial Intelligence (AI) is becoming integrated into most key processes, including manufacturing, customer service, infotainment, and Advanced Driver Assistance System (ADAS) features.

Automobile manufacturers worldwide are expanding their capabilities to leverage data, which is becoming an essential component of many operations. They are also developing new AI-driven strategies, many of which incorporate autonomous driving features. In 2022, the global automotive AI market was estimated at USD 2.71 billion, and it is projected to reach USD 15.23 billion by 2030, demonstrating a CAGR of 24.1% from 2022 to 2030.



As a dedicated technology partner to some of the world's most prominent automotive manufacturers, Avenga is closely monitoring the industry's trends, challenges, and regulatory changes. This knowledge enables us to gain a nuanced understanding of our clients' needs and priorities, as well as ensure that the solutions we build are consistently aligned with the latest advancements in the automotive sector.

The aim of this report is to highlight how some of the key automotive players are leveraging the latest AI technologies to enhance operational efficiency, future-proof their businesses, and secure a competitive edge. In the last sections of this publication, we also outline the elements of a typical AI platform on which a variety of use cases can be built and share a few general predictions regarding AI's impact on the industry in the near future.

AI in automotive: application overview

AI is rapidly transforming various sectors of the automotive industry. The recent proliferation of predictive models, coupled with the increased availability of computing power, has led to significant advancements in vehicle safety, autonomous technologies, and the overall driving experience. Although it is almost impossible to list all the different ways in which car manufacturers around the world are applying AI, this paper will attempt to cover some of the key uses by some of the biggest industry names.

Autonomous driving

Most large manufacturers seem to have abandoned aspirations for L4 and L5 autonomous cars, as exemplified by Ford's folding on Argo AI earlier this year. Nevertheless, the fervor for releasing L3 autonomous vehicles, as well as perfecting existing L2 functionalities, remains a prevalent theme within the industry. Predictive algorithms form the basis of autonomous driving features. Data scientists within automotive companies actively experiment with Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), Transformers, and various other network architectures to get the best results in sensor fusion, object detection and classification, path planning and lane keeping, navigation decision-making, and so on.

Advanced Driver-Assistance Systems (ADAS)

As AI technologies advance, AI-enabled ADAS features are also becoming increasingly sophisticated, enhancing driver safety and comfort. Vehicle manufacturers apply these algorithms to power features such as lane departure warning, adaptive cruise control, automatic emergency braking, blind spot monitoring, and parking assistance. With AI capabilities, ADAS systems can effectively detect potential hazards, react promptly, and provide timely warnings or interventions.

In-car intelligent operating systems

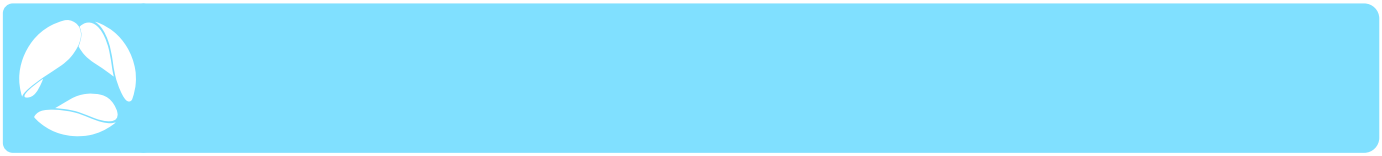
Automotive companies are increasingly employing AI-powered voice recognition to enable intuitive voice commands for controlling various vehicle functions, such as navigation, entertainment, climate control, and smartphone integration. Also, the models can facilitate personalized recommendations for music, destinations, and other services based on user preferences and driving patterns.

Predictive maintenance

AI-powered predictive maintenance systems analyze vehicle data from sensors, including engine performance, fuel consumption, and component wear, in order to identify potential issues before they cause breakdowns. AI algorithms can detect anomalies, predict component failures, and alert drivers or service centers to schedule maintenance proactively.

Manufacturing and design

AI is employed in manufacturing processes to optimize production lines, monitor equipment health, and improve overall operational efficiency. Predictive algorithms can anticipate equipment failures, reduce downtime, and minimize production disruptions. In addition to that, AI is increasingly used to create digital twins of vehicles, enabling engineers to virtually test and optimize designs before physical prototypes are built.



Mercedes-Benz: streamlining driver's experience with personalization

Mercedes-Benz's Drive Pilot

Mercedes-Benz employs AI for their Drive Pilot, which so far is the only SAE Level 3 system for automated driving approved for sale in Europe and the US. The platform is meant to create a huge paradigm shift in the driver experience.

Unlike Mercedes-Benz's Active Distance Assist DISTRONIC, as well as Active Steering Assist features, which don't let drivers take their hands off the steering wheel, Drive Pilot can completely take control over driving when specific conditions are met.

For example, the system is capable of smoothly operating at 40 mph in traffic jams on a pre-mapped freeway network approved by Mercedes-Benz. Drive Pilot uses LiDAR, radar, cameras, and ultrasonic sensor data, as well as regularly updated high-definition maps, which provide accurate road geometry information and enable easy navigation.

Mercedes-Benz's GenAI applications

In-car voice assistant

Mercedes-Benz has announced an investment of over $2.2 billion by 2030 to train employees as data and AI specialists. The company is currently training over 600 employees from various areas within the group to become experts in data and AI.

Obviously, the company is eagerly participating in the race to harness AI. Recently, they integrated Large Language Models (LLMs) and GenAI into their workflows, both for customer-facing applications and back-office operations.

They are using ChatGPT, a widely recognized GenAI tool, as the engine for their voice assistant. The system is currently available in beta on more than 900,000 vehicles, and Mercedes-Benz is the first company to employ the technology on this scale.

Just a few months after the release of ChatGPT, the advantages of incorporating the model into a Mercedes-Benz vehicle were showcased at the Consumer Electronics Show in January 2022. Following a positive response, further research into this area was

initiated. Subsequently, in February, the technology was demonstrated to media, analysts, influencers, and researchers. Given the overwhelmingly favorable feedback, Mercedes-Benz decided to introduce the assistant to their customers.

The company enhanced its existing "Hey Mercedes" tool, which Mercedes-Benz drivers rely upon for navigation and various vehicle control functions, with ChatGPT functionality, thus enabling it to operate within a broader domain. So far, the GenAI update has been made available only to US clients who can request it through a Mercedes-Benz app or directly from their vehicles. However, the company has made it clear that it has plans to expand the reach of the project in the very near future.

ChatGPT for vehicle production optimization

Mercedes-Benz is also ensuring that its production line workers benefit from the utilization of ChatGPT and has incorporated a GenAI-powered bot into their production processes.

What led up to this was that the company opted to enhance its digital production ecosystem MO360 through a collaboration with Microsoft Corp. This partnership resulted in the creation of the MO360 data platform, which serves to aid the Stuttgart-based car manufacturer in achieving dynamic prioritization of production resources and more rapid identification of supply chain bottlenecks. The platform makes use of Microsoft Azure to standardize and unify data, providing Mercedes-Benz with the cloud capabilities and flexibility necessary to deploy AI and analytics functionalities on a large scale. Additionally, it enables them to address various cybersecurity threats and ensure compliance across different regions.

In essence, the MO360 Data Platform empowers Mercedes-Benz to create virtual replicas of their manufacturing processes and gather essential insights across various phases, from planning and assembly to supply chain management and quality control. This comprehensive approach opens up opportunities for operational optimization.



Using ChatGPT within this digital production ecosystem represents the next step in enhancing the analysis of production and quality management data. The tool is accessible to employees through a voice-based interface, leveraging the Azure OpenAI service, which offers the capabilities of Microsoft's enterprise-grade cloud and AI platforms.

The bot facilitates more efficient networking of quality data from development, production, and customer experience, significantly expediting the identification and analysis of malfunctions. Furthermore, through data clustering, ChatGPT simplifies complex assessments and presentations of quality management and other production-relevant data, presenting them in easily comprehensible formats.

The assistant also enables non-technical employees to access necessary production data easily through a dialogue format, eliminating the need for complex programming commands. This user-friendly method of information retrieval allows staff to refine their queries until they obtain the level of detailed insights required. Additionally, daily production planning is accessible to all employees, allowing for quick adjustments. With data readily available, every staff member can make prompt estimates and evaluations. The bot supports strategic decision-making throughout the entire production chain.

After the pilot phase is completed, Mercedes-Benz plans to implement ChatGPT across its global production market.

AI in Mercedes-Benz's infotainment and loan approval processing

In terms of infotainment, Mercedes-Benz's MBUX system relies on AI to understand natural language voice commands and to learn drivers' preferences over time. The system records drivers' behavioral patterns and anticipates their next requests. Additionally, it can recognize hand and arm movements, distinguish between the hands of the driver and the front-seat passenger, and execute appropriate functions.

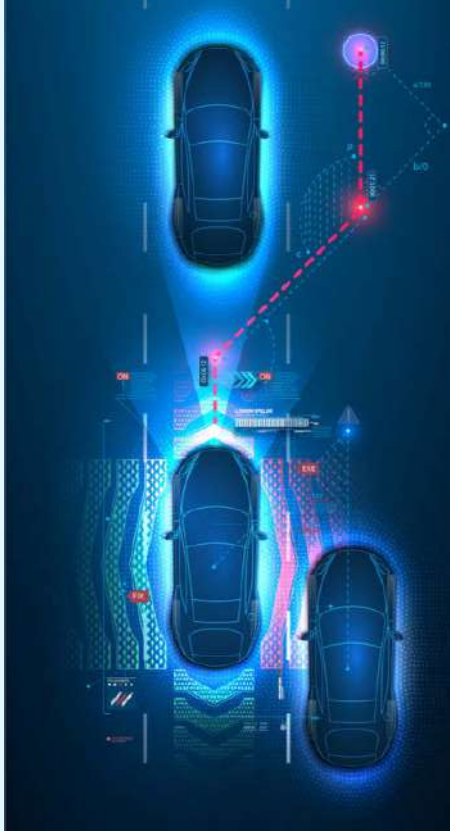
Lastly, the company is actively working on an AI Credit Agent, which employs Machine Learning (ML) algorithms to simplify the loan approval process. The goal is to automate as much of the credit process as possible and reach a point where clients receive responses to inquiries within seconds, along with alternative options.

BMW: transforming key capabilities with AI

BMW's upcoming L3 vehicle

BMW is also experimenting with an L3 autonomous driving program. They've recently teamed up with Innoviz, a LiDAR manufacturing company, and have announced plans to roll out L3 vehicles in 2024.

The company is also working on a LiDAR-based Minimal Risk Maneuver (MRM) system to help manage real-time driving decisions as a secondary safety platform that leverages the advanced performance, reliability, and resiliency of the InnovizTwo LiDARs.



BMW's use of generative AI

BMW uses GenAI for manufacturing process optimization. It leverages something known as Generator Enhanced Optimization (GEO). Specifically, they have used a quantum-inspired generative model for the plant scheduling optimization task. The model was trained on the solutions generated by other state-of-the-art optimizer networks and then proposed novel and more effective alternative optimization options.

Zapata AI, BMW's partner on this project, reports that they ran about a million optimization run cycles across many different configurations, algorithms, and optimizer categories and found the most effective solution for each issue. GEO outperformed other state-of-the-art tools by 71%, helping BMW significantly improve plant scheduling efficiency, minimize idle time, and meet production targets.

BMW's AI-powered sustainability efforts

BMW has successfully developed an extensive data and AI ecosystem that harnesses the collective efforts of thousands of employees. This endeavor has resulted in the creation of numerous meticulously curated data assets, which can be employed in a recurrent manner. Furthermore, their innovative work has been instrumental in amalgamating previously isolated data sources.

Since 2019, the company has delivered more than 800 use cases, yielding a value exceeding one billion USD. BMW's primary strategic focus lies in the realms of sustainability and mobility.

Currently, over 60% of the global population resides in urban and near-urban areas, which collectively contribute to approximately 70% of urban emissions. Consequently, the company has strategically positioned itself to empower urban planners by harnessing the capabilities of AI in three pivotal ways:

- **Employing ML models to forecast the local environmental impact of new traffic regulations in terms of gas emission reduction.**
- **Assisting city planners in identifying areas lacking an adequate charging infrastructure, a factor that often deters individuals from transitioning to electric vehicles.**
- **Predicting the impact of alterations in pricing policies on commuters' route selections, consequently allowing for estimations of traffic and emissions.**

These three critical challenges are intrinsically linked to geospatial data, necessitating the proficient utilization of geoservices, map matching, geohashing, and the integration of digital maps with ML.

Examination of BMW Group's geospatial capabilities through AI

In the context of fleet customers, especially those operating large fleets, predicting the proportion of vehicles that will transition to electric power in the future can be a challenge. The company's strategic objective entailed training AI models to discern correlations between engine types and driving patterns. The underlying rationale was that if such correlations could be established, the algorithm could gauge a driver's predisposition to switch to an electric vehicle in the future.

The data utilized for this purpose underwent a comprehensive anonymization process, thereby mitigating any risks associated with customer data privacy. The solution operates as follows:

- Raw GPS data, anonymized in its entirety, is sourced to determine the geographic routes of vehicle operation and parking.
- These GPS traces are processed to form coherent routes through map-matching procedures.
- The derived routes are structured in a manner akin to sentences, with landmarks along these routes serving as pivotal elements. An advanced Natural Language Processing (NLP) model is subsequently employed to predict the routes preferred by electric vehicle drivers.
- A separate AI model is engaged to cluster vehicle parking locations and forecast the likely areas where electric vehicles will be stationed.
- Integration of the two models enables a triangulation of predictions. Post-training, the hybrid algorithm exhibits a remarkable 80% accuracy in forecasting the likelihood of specific fleets transitioning to electric vehicles.

Throughout the training phase, a standardized set of common APIs (application programming interfaces) was implemented, facilitating seamless access, data enrichment, and the transformation of geospatial data. Supplementary algorithms were deployed to partition the raw geospatial dataset based on geospatial boundaries, allowing for the effective utilization of data segments in both training and inference processes.

AI in vehicle assembly at BWM

In 2019, BMW made headlines by applying AI capabilities in its South Carolina plant, which produces about 60% of the vehicles sold in the United States. AI manages the work of robots that weld up to 400 metal studs onto the frame of every SUV. It checks if the studs are correctly placed and makes the robots implement corrections when required, all without human involvement. This AI stud correction layer saves the company about $1 million in production costs each year and has enabled it to dramatically improve efficiency. The technology has also allowed the company to remove some workers from the production line and redeploy them into other, more complex areas.

The inspection process is also enhanced through the use of AI. As vehicles move down the line on the factory floor, about 26 cameras start snapping pictures, which are then

relayed to an ML model that can quickly and accurately identify issues and flag them for fixing. Before the technology was introduced, human workers couldn't possibly check every vehicle, but with AI, more thorough and faster inspections are now possible.

In addition, factory workers at BMW wear scanner devices that measure and take high-resolution images of every part of the plant. This visual data is then used to create a highly accurate virtual representation of the factory. These digital twins enable the employees to promptly estimate which adjustments are needed and how modifications will affect the plant's efficiency before implementing them in the real world. With this technology, the time of factory scanning is reduced from months to days, and the company wants to keep training the models to the point where they can analyze and suggest new ways to improve the efficiency of BMW's automated assembly line.

Furthermore, a dedicated AI system helps the robots at the plant better recognize various objects like containers, boxes, machines, building structures, and people. This technology helps the machines improve their navigation skills within the plant and calculate alternative routes within milliseconds in case an obstacle appears. All of this contributes largely to production efficiency.

BMW's proactive care initiative

BMW has recently announced a proactive care initiative, which is meant to elevate the level of customer service by predicting maintenance needs before they turn into problems.

Service-related data from the vehicle is gathered and sent to the cloud for analysis, after which a predictive algorithm forecasts the car's needs to keep it in optimal condition at all times. The system is also trained to notify users (everyone who has opted for this functionality) through various channels about the predicted services, including through calls in the most critical situations. Also, to ensure transparency, BMW plans to send the clients videos detailing how they capture and anonymize data, describing issues that need to be dealt with and the expected duration of repair, costs, and so forth.

BMW's AI-enabled infotainment

In infotainment, BMW uses AI for standard features such as voice control in their Intelligent Personal Assistant, which enables drivers to control the infotainment system, get information, make phone calls, and more. The models are used for both navigation and entertainment; the system learns the driver's preferred car settings and infotainment modes and then activates them automatically.

As part of BMW's Connected Drive, AI technologies enable drivers to get updates on their car's status, ease navigation (which includes finding points of interest), and use preconditioning (optimizing cabin temperature before the driver gets into the car while prolonging the life of the battery at the same time).

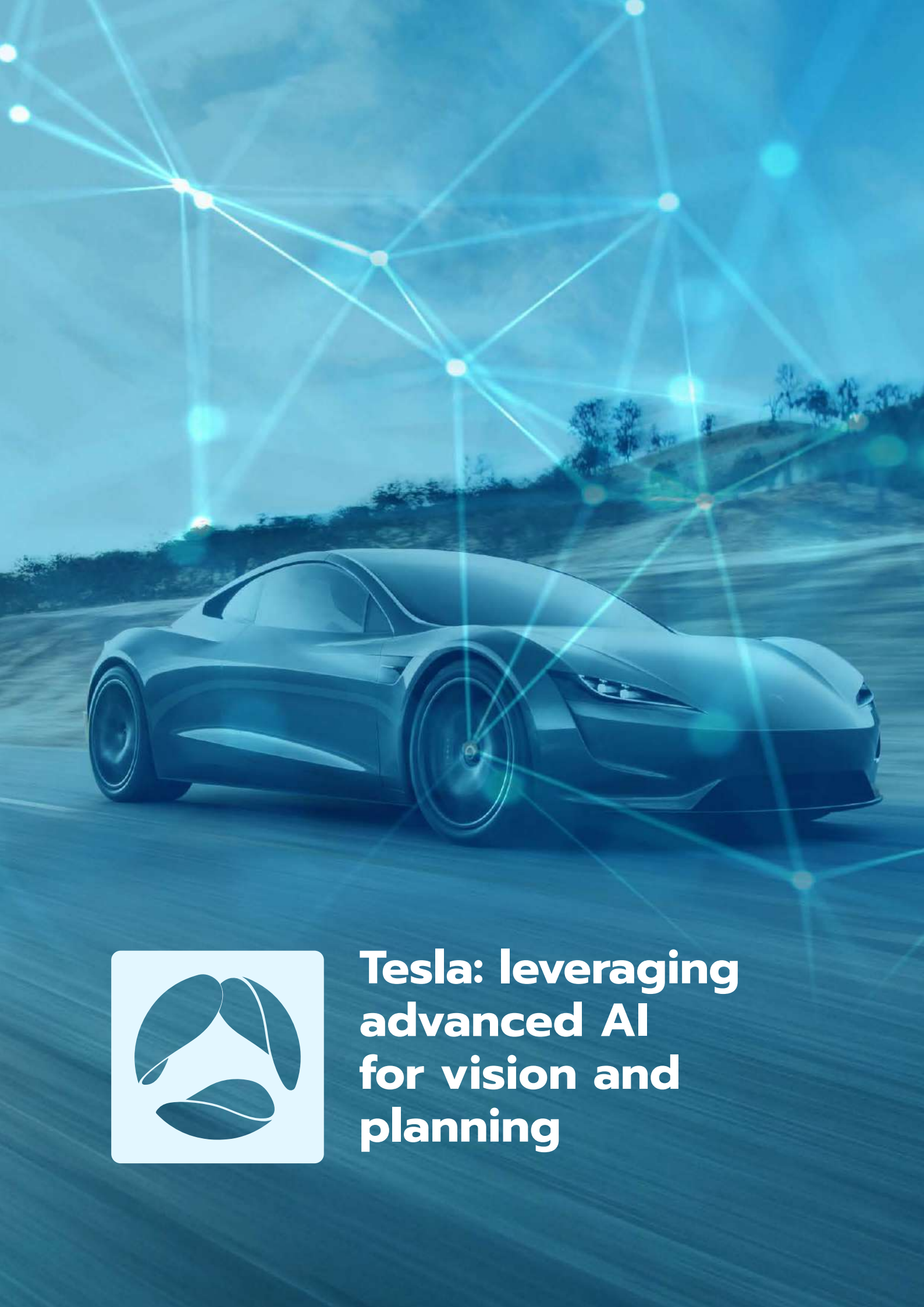
Other interesting applications of AI by BMW

BMW has reportedly experimented with an AI-based system for energy consumption management too. The system learns a user's behavior and route information to optimize energy management within the vehicle, taking into account the user's needs and efficiency requirements. It has also been working on adding an audio signal processing model to help drivers better monitor their surroundings, especially in urban areas.

AI models are also actively being used for specification document processing. These models can automatically translate text and check for consistency, similarity, and overall linguistic quality of thousands of documents.

Furthermore, BMW has an AI application that speeds up logistics processes and helps prevent the unnecessary movement of empty containers on the conveyor belt. It easily identifies the needed containers and sends them to the removal station via the shortest route. The computer vision model takes as input visual data marked by employees to determine whether a container can be lashed onto a pallet as is or if additional securing is needed.

In terms of business processes, AI is also used by BMW for machine translation. Specifically, German repair instructions are translated into more than 30 languages, and the use of machine translation tools has allowed the company to reduce translation time by 75% while also significantly improving the quality of translation. Overall, with the help of this tool, the company expects to provide synchronous translations across all its business processes, as well as to customers, much faster and at a much lower cost.



Tesla: leveraging advanced AI for vision and planning

Tesla's Full Self-Driving

Tesla has recently released the Full Self-Driving (FSD) beta, which can navigate most roads quite effectively despite being a Level-2 system that still requires constant attention (hands-on and eyes-on) from the driver. Even though it's not yet L3, there are persuasive stats as to FSD's overall successes:

- Over 100,000 people are currently using Tesla's Full Self-Driving beta.
- Using the program, 300 million miles have been driven.
- A few years ago, it was estimated that FSD could potentially prevent up to 90% of road accidents.
- Tesla vehicles operating on non-highway routes with Full Self-Driving (FSD) engaged have experienced just 0.31 accidents per million miles. This represents an 80% reduction in accidents compared to the average vehicle.

The company's reluctance to embrace LiDAR technology is often cited as the reason it hasn't progressed to the next level.

Up until 2022, Tesla had one of the world's leading computer vision (CV) experts, Andrej Karpathy, leading their AI Autopilot CV team. Today, it remains at the forefront of AI-powered autonomous driving technology, actively experimenting with various neural networks to tackle autonomous driving challenges, from object perception to vehicle control.

Tesla utilizes per-camera networks for raw image analysis, semantic segmentation, detection, and monocular depth estimation tasks. For video analysis, road layout creation, and the interpretation of static infrastructure and 3D objects from a top-down perspective, birds-eye-view networks are employed.

The company's LiDARless system is comprised of about 50 neural networks that are trained on a vast array of complex and diverse scenarios sourced from millions of vehicles in real-time. Together, these models generate thousands of predictions at each timestep.

Furthermore, Tesla is experimenting with core algorithms that generate high-fidelity representations of the real world and allow the vehicles to plan movement trajectories effectively.

For these reasons, Tesla collects data from over 1 million of its vehicles in order to train its AI systems. In 2021, it was reported that Elon Musk's company had over 1,000 individuals labeling data objects for ML algorithms.

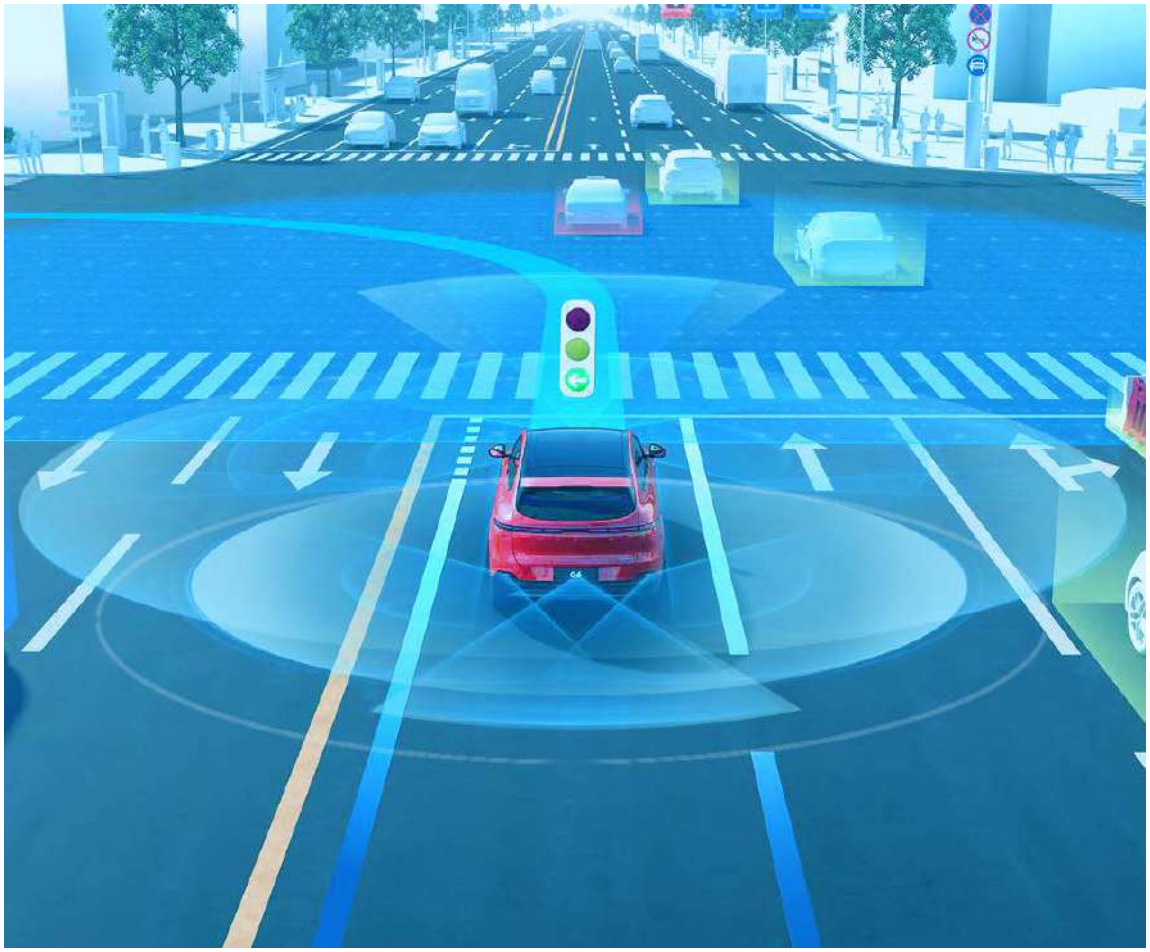
XPENG: transforming operations with AI to become a top EV innovator

XPENG's answer to FSD

Like Western manufacturers, their Chinese counterparts are also heavily employing AI for a variety of purposes. XPENG, a prominent Chinese car manufacturer, recently rolled out an advanced update of its XNGP Advanced Driver Assistance System (ADAS), which many say, rivals Tesla's FSD. Unlike Tesla, XPENG's autonomous driving function is not based solely on camera sensors, but also involves LiDARs. In addition to AI-powered self-driving capabilities, the system also offers enhanced SR (Simulated Reality) 2.0 features enabled by XNET perception technology. The upgraded visual display provides a bird's eye view and a 360° panoramic environmental perception of surrounding road conditions across more than 8 lanes, allowing it to identify both safe and restricted areas. XPENG claims its system excels in terms of faultlessly recognizing lane markings like dashed lines, arrows, stop lines, and zebra/crosswalk crossings.

Thanks to XPENG's industry-leading XNet deep learning neural network, backed by China's largest autonomous driving supercomputing center and its self-developed closed-loop AI and data system, their new system possesses robust AI learning capabilities. Not only does it rapidly accumulate driving expertise, but it also significantly accelerates the expansion of coverage in new cities.

XNGP effectively handles both urban road driving scenarios as well as highway scenarios (for which close to "zero intervention" is needed.)



XPENG's intelligent cockpit

The AI-powered intelligent cockpit system described by XPENG is advanced and highly customizable. Here are some key points about it:

Customization:

The system allows users to customize nearly all car functions according to their preferences. This includes settings related to climate control, seating positions, and more.

Awareness:

The system is designed to be aware of both internal and external environmental conditions. For example, it can detect high temperatures inside the vehicle and initiate the "rapid cooling" function before the user enters the car, ensuring a comfortable temperature.

Scheduling:

The system can be programmed to respond to a user's schedule. For instance, on weekdays at noon, it can automatically adjust the backrest, screen, and air conditioning to specific settings when the user takes the driver's seat.

Voice assistant:

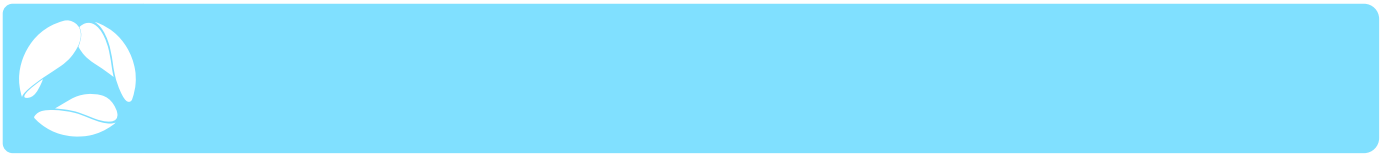
The system includes a voice assistant that enables interaction with the car to activate various functions, provide reminders, and more.

Multi-function customization:

XPENG claims that the system offers over 350 vehicle-side capabilities, which can be combined to create flexible and highly personalized scenarios.

Sharing:

Users can easily share their customized scenarios with others through popular platforms like WeChat and Weibo, as well as the XPENG mobile app. This feature enhances the social and collaborative aspects of the system.



Baidu: shaping the future of mobility

Baidu's L4 autonomous driving capability

Baidu, often referred to as the Chinese Google, is involved in the development of driverless cars, among other projects. Last year, the company released the Apollo RT6, a fully autonomous passenger vehicle designed specifically for urban autonomous mobility.

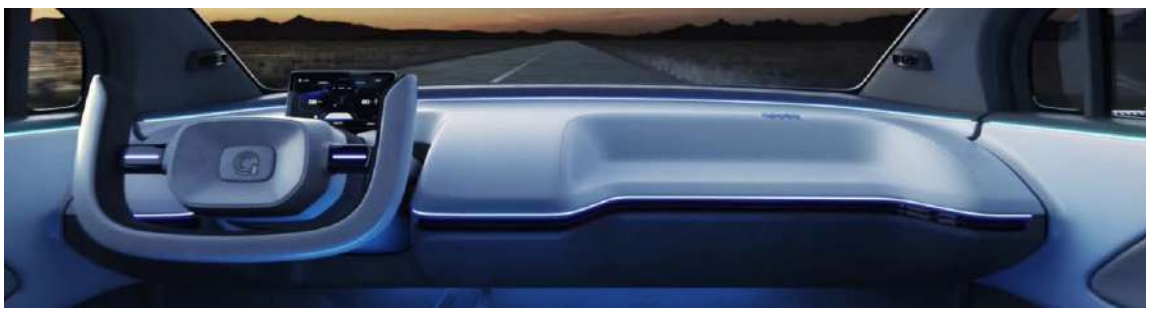
This car, used for robotaxi services, relies on Xinghe, Baidu's internal automotive E/E architecture for autonomous driving. It boasts a Level 4 autonomous driving capability, meaning it can operate safely without requiring human intervention. In fact, no human driver presence is needed at all, and the car's steering wheel can be detached to free up additional cabin space.

Apollo RT6 taxis are equipped with a 5G-powered "Remote Driving" service, which enables a human to take control of the vehicle remotely in case of an emergency. The neural networks powering the self-driving capability in RT6 were trained on an extensive dataset, the world's largest for self-driving vehicles, which was also produced by Baidu. This is why the company's representatives often liken the algorithm to an expert human driver with 20 years of experience.

The car features 1,200 TOPS (trillions of operations per second) of computing power and 38 onboard sensors, including 8 LiDARs and 12 cameras, which ensure safe navigation even in complex urban environments. The effective fusion of sensor data, along with powerful processing algorithms underpinning the self-driving capability, allows the car to create a highly accurate long-range perception in a 360-degree field around the vehicle and makes real-time driving decisions.

Apollo Go, the service through which a Robotaxi can be summoned, currently operates in ten cities across China. Baidu is also the first company in the country to launch unmanned commercial pilot operations in cities with particularly complex driving environments, such as Beijing, Chongqing, Wuhan, and Shenzhen.

As of now, Apollo Go reports they've processed over 3.3 million ride orders and achieved an overall user satisfaction rating of 4.9 out of 5. A remarkable 97.12% of their user reviews are five-star ratings.



GenAI at Baidu

Like Mercedes-Benz in Europe, Baidu also intends to incorporate GenAI capabilities into self-driving cars, collaborating on this initiative with other automotive companies such as Great Wall Motors, Lynk & Co, and Smart. However, as of now, the specific details of the project have not been disclosed.

What's known is that the Chinese manufacturers will utilize Baidu's Ernie 3.5 LLM, which is said to be comparable and in some aspects superior to the highly popular GPT-4, to power their in-car assistant. According to Baidu's representatives, numerous test vehicle interactions and explorations have already been conducted, and several innovative LLM-powered features have been validated on mass-production vehicle platforms. These features include car consultancy, knowledge-based Q&A, journey planning, and creative drawing. The latter feature is operated by a text-to-image system designed to entertain children during trips.

A connected AI platform - the basis for AI applications

Connected experiences are something many modern drivers have come to expect from their vehicles, especially the owners of premium-class autos. And AI, or rather the proper extensions and optimizations of existing data processing functionalities by automakers, is a key tool for addressing these demands. Connected experiences encompass many different services, which necessitates the need to scale AI across many areas and workflows. To make this happen, a consolidated AI-connected platform (a base on which many AI-related flows can run) should be set up and integrated within the vendor's ecosystem.

This is about connecting DevOps engineers, who are simultaneously cloud and AI infrastructure experts, with data scientists, whose job is to apply and experiment with novel ML models by using Python and the latest ML toolkits. The DevOps teams are mainly responsible for provisioning into the use case owner's accounts (a CI/CD pipeline is typically utilized here) while the data scientists are in charge of implementing use cases and setting up different pipelines within the platform. The point of the platform is to abstract some of the most time-consuming and tedious challenges from the teams. This means that data scientists can focus on models and pipelines without having to worry about access, infrastructure security, storage, identity, etc., while DevOps engineers can reduce their operational risks.

The architecture of the platform typically goes like this:

At the very bottom, there's the vehicle whose sensors and systems are data sources. There are two types of data: historical and real-time. The former type is used to train the models and for batch inference. The real-time data is for live predictions.

At the very top of the architecture are consumer entities, which could be web customer portals, the manufacturer's app, or some other place the outputs are routed to.

The connecting element, **the middle layer,** between these two components is the connected AI platform, which is often an extension of the connected services cloud platform, which most vendors are already actively using. This is typically a Kubernetes-based platform for microservices.

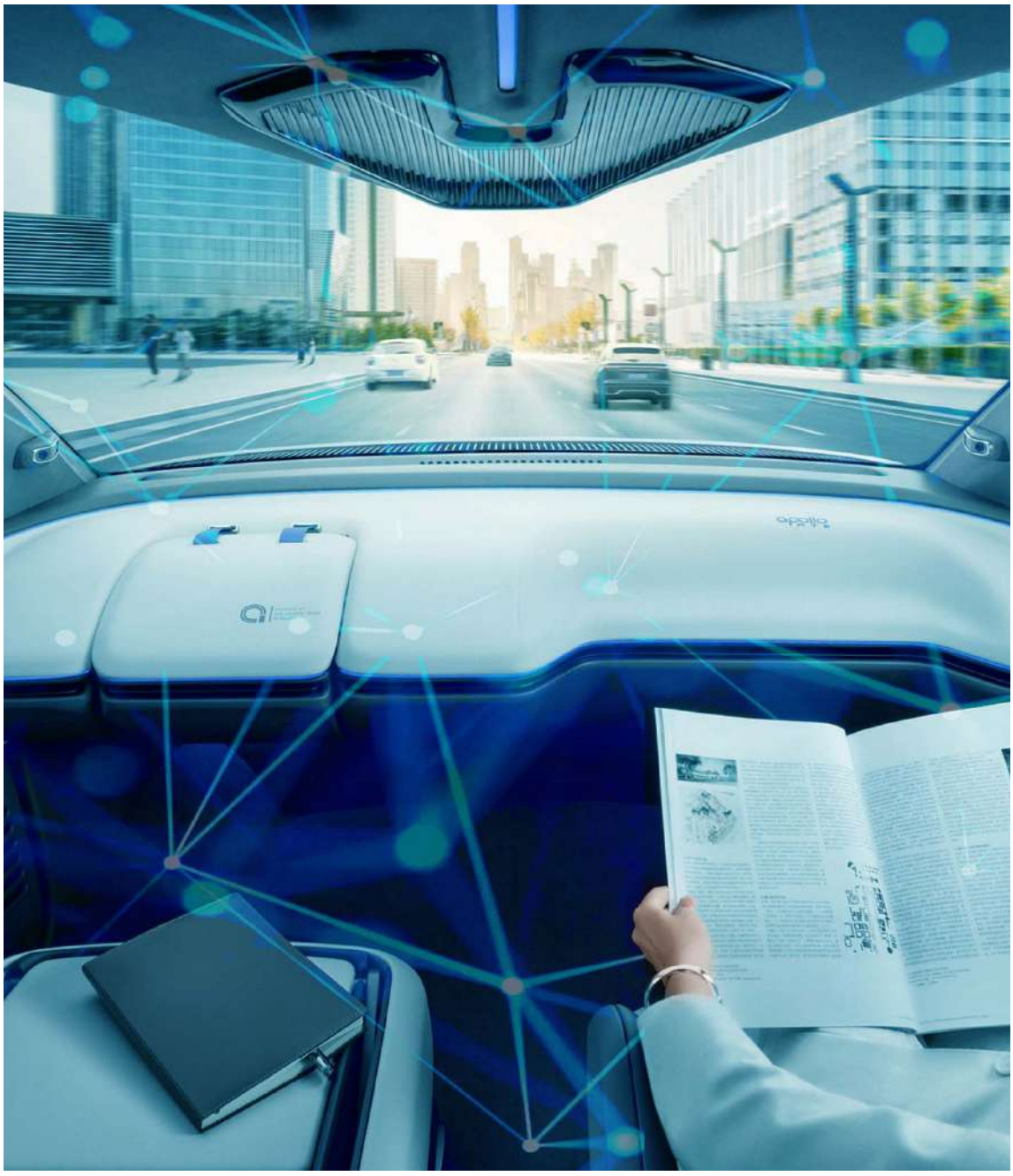
The engine commonly used for AI platforms built on top of the Kubernetes (K8s) microservices platform is Kubeflow – the tool that uses MLOps principles for data science. It's an open-source framework that ML experts use to deploy and analyze ML workloads with relative ease. Additionally, there should be a notebook server within the platform. The Jupyter Notebook is an important element in this system as it allows the analysis and exploration of data, which in turn, gives data scientists a chance to better evaluate all the ML steps.

Kubeflow's many perks include the feature to spawn jobs, not only within the K8s cluster (inside of which the tool is running), but also within a cloud server. The jobs might include the data pre-processing job, the feature engineering job, the model training, and post-processing jobs, as well as many jobs related to cloud services, such as Elastic MapReduce in the case of AWS.

The resulting model can be deployed within the K8s cluster, which offers certain benefits, such as that it enables the algorithm to interact with services already running within the K8s cluster. This is important because an automotive ML application is not solely a predictive algorithm, but a platform comprised of many other features and systems.

A functionality for model monitoring is also a crucial element. The ML algorithms, which all have a finite amount of accurate performance, should be continuously observed and, upon decreases in performance, improved by rerunning a training pipeline, which in turn, would lead to the creation of a new model that is based on new data.

The AI-connected platform can support a multitude of use cases, one of which is predictive vehicle maintenance. The platform works by collecting data from the vehicle (to which the customer/driver has to consent first). The data then goes to the cloud, where there are DevOps engineers constantly improving the platform's efficiency and data scientists working on Kubeflow pipelines. There are usually two Kubeflow pipelines: one that absorbs vehicle data to train the model, and the other pipeline takes the specific vehicle data to predict a maintenance need. If a need for maintenance is identified, the service consultant at an organization can then be alerted, who then reaches out to a driver via their preferred communication channel to schedule a service appointment. This way, the car can be taken care of before any damages appear.



Looking ahead: our top 3 predictions for the near future of AI in automotive

1 Increased use of AI in customer-facing applications

The applications of AI technologies in customer support and other customer-facing areas have been expanding. Chatbots, virtual assistants, and AI-driven analytics are increasingly used to enhance customer service and engagement. Driving the trend is the demand for efficiency among car manufacturers and the high-impact business outcomes the companies were able to achieve through AI-enabled customer service improvement.

2 Advancements in ADAS and autonomous driving

The development of ADAS and autonomous driving technologies has lately been a focal point for many automotive manufacturers. AI models play a crucial role in improving the capabilities and safety of these systems. As is evident from this report, automotive manufacturers are in a race to outpace each other in delivering autonomous driving capabilities. This competition will continue to drive the continuous adoption of sophisticated AI technologies to make vehicles safer and more autonomous.

3 Growing use of Large Language Models (LLMs) within in-car assistance and infotainment

Large Language Models, such as Natural Language Processing (NLP) models, are being integrated into in-car assistance and infotainment systems. As they become sophisticated and ubiquitous, we can expect more car manufacturers to follow Mercedes-Benz and expand the capabilities of their existing assistive and infotainment technologies through the incorporation of LLMs. The current trend toward voice-activated systems in vehicles is promoting even more the integration of LLMs for hands-free control and improved user engagement.

Outro

As we conclude this report, the transformative impact of Artificial Intelligence (AI) on the automotive industry is undeniably profound. Noteworthy achievements, ranging from enhanced operational efficiency to enriched self-driving capabilities to elevated customer experiences, stand as a testament to the industry's embrace of AI.

AI technologies continue to evolve rapidly, paving the way for exciting advancements in 2024 and beyond. By leveraging Machine Learning (ML) algorithms and predictive analytics, automakers gain unparalleled insights into consumer behavior while delivering personalized services and targeted marketing campaigns.

While this work examined several leading manufacturers currently utilizing AI technology extensively across various domains, from manufacturing processes to autonomous driving development, a vast landscape remains unexplored.

Therefore, in our next installment, which is scheduled for release soon, we will delve even deeper into how other esteemed carmakers harness the power of AI. Meanwhile, feel free to contact us here to discover the ways AI technologies can empower your transformation journey.


your
competitive
advantage