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AI Foundation Models' Impacts on Vehicle Intelligent Design and Development Research Report, 2024

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How foundation models will rebuild intelligent vehicles?

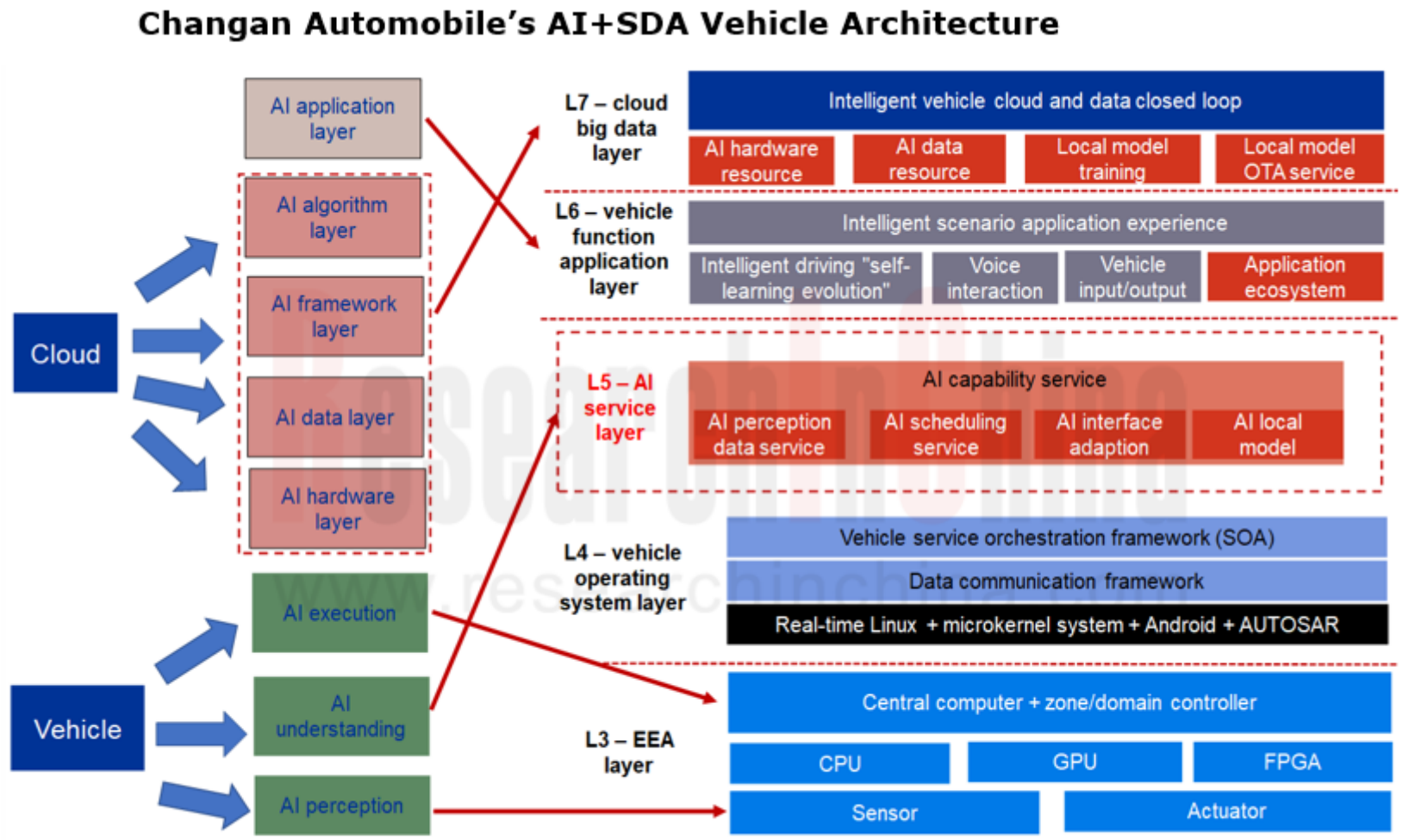
AI foundation models are booming. The launch of ChapGPT and SORA is shocking. Scientists and entrepreneurs at AI frontier point out that AI foundation models will rebuild all walks of life, especially tech-related fields. As a technological product, how will intelligent vehicles be changed by AI foundation models?

How foundation models will rebuild intelligent vehicles?

Following the "Automotive AI Foundation Model Technology and Application Trends Report, 2023-2024", a report which discusses impacts of AI foundation models on automotive industry from a macro perspective, ResearchInChina released the "AI Foundation Models' Impacts on Vehicle Intelligent Design and Development Research Report, 2024", the second report which researches the impacts of AI foundation models on vehicle intelligent design and development in the such aspects as hardware, operating system, application function, and cloud big data.

In 2023, Changan Automobile added AI edge and AI service layer to the original software-driven architecture (SDA) that includes L1-L6 layers. It can be seen that AI technology has affected most layers of intelligent vehicles: L3 EEA layer, L4 vehicle OS layer, L6 vehicle function application layer (including cockpit, connectivity and intelligent driving), L7 cloud big data layer, etc. The chassis part of L1 mechanical layer and the battery part of L2 power layer have actually involved AI application.

Changan Automobile's AI+SDA Vehicle Architecture



Source: Changan Automobile

Application Cases of AI Foundation Model in Layers of Vehicle Intelligent Architecture

Currently, OEMs and Tier1s apply foundation models to part of vehicle intelligence, or to some link in the development process.

Application Cases of AI Foundation Model in Layers of Vehicle Intelligent Architecture

Automotive Layer	Development Scenario	Application Case
Hardware	Chip, sensor	• Chip design: NVIDIA ChipNeMo • Sensor: Infineon + Archetype AI
Operating System	SOA, operating system	• SOA: GAC Xingling Architecture, Changan SDA Architecture • Vehicle OS: HarmonyOS/Xiaomi HyperOS/ThunderSoft DISHUI OS
Application Function	Autonomous driving/intelligent cockpit	• Autonomous driving perception: Bosch multimodal foundation model • Intelligent cockpit: Li Auto Mind GPT/iFLYTEK Spark foundation model • Intelligent Driving: SenseTime Uniad/Haomo.ai DriveGPT
Cloud Big Data	Data closed loop/simulation system/cloud platform	• Data closed loop: SenseTime SenseAuto Empower • Simulation system: Megvii Technology ADriver-I • Cloud platform: Tencent Cloud/Huawei Cloud

Source: ResearchInChina

What is AI Agent?

When viewing the general application trend of AI foundation models in vehicles, we also need to find an idea in the evolution of foundation models. According to the results of Tencent Research Institute, AI will evolve from the brain to AI Agent, and from CoPilot to autonomous driving.

So, what is AI Agent?

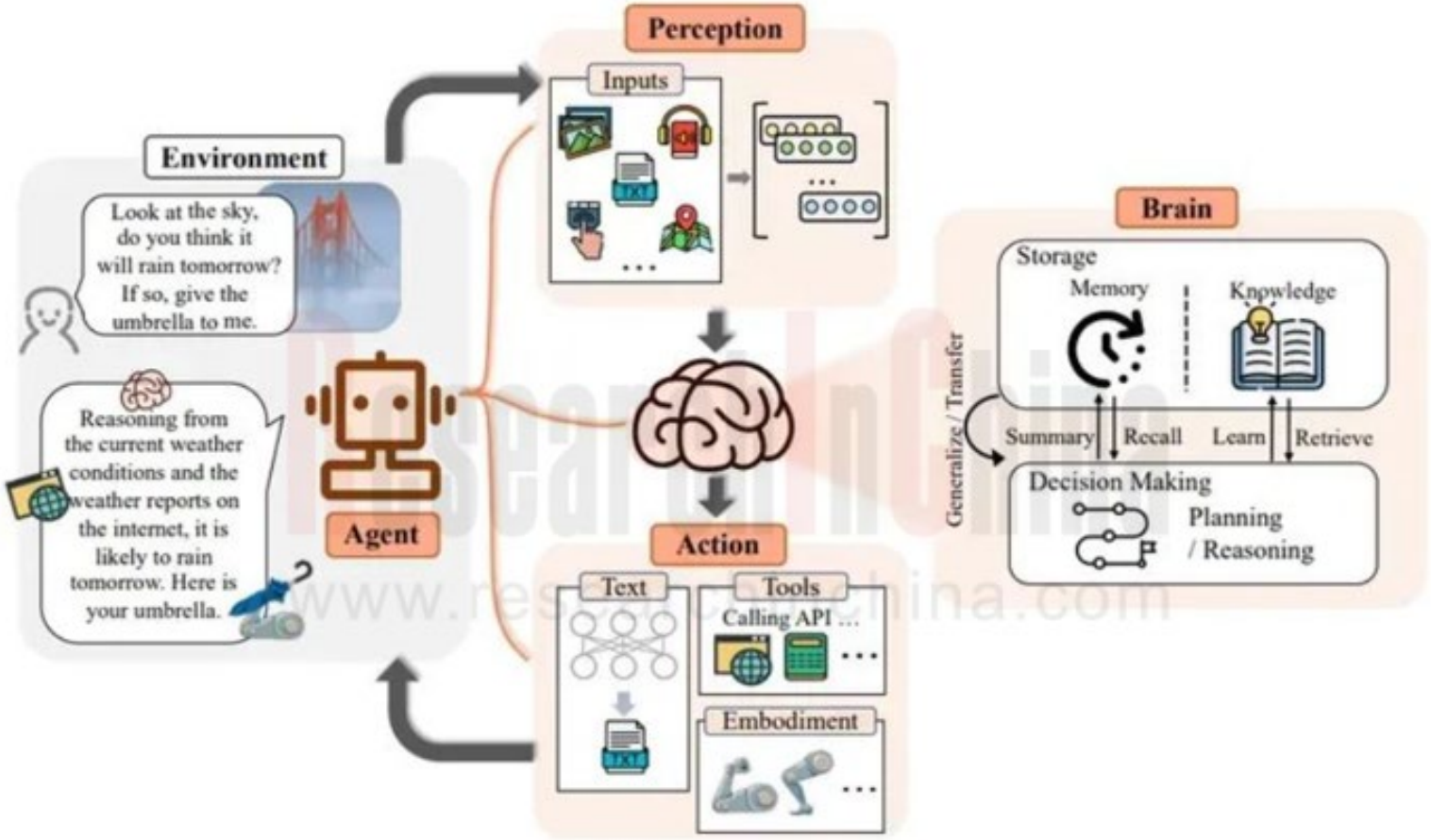
Will foundation model/AI Agent replace OS/APP?

ResearchInChina accepts the view: AI foundation model is the OS, and AI Agent is the application. The development paradigm of intelligent products will be changed from conventional OS-APP ecosystem paradigm to AI foundation model-AI Agent ecosystem paradigm.

What is AI Agent? It is an artificial intelligence (AI) system beyond simple text generation. AI Agent uses a large language model (LLM) as its core computing engine, so that it can make conversations, perform tasks, make inferences, and have a degree of autonomy. In short, AI Agent is a system with complex reasoning capabilities, memory and task execution methods. It is thus clear that NOMI GPT in NIO's cockpit and Tesla FSD V12 are AI Agents in the cockpit domain and intelligent driving domain, respectively.

Source: Internet

AI Agent



Source: Zhihu

AI foundation models

AI foundation models, a platform-level AI technology, include those launched by first-tier technology companies, such as ChatGPT and ERNIE Bot. Platform-level AI can serve as the technological foundation to empower operating systems in all aspects. It is regarded as the new kernel of next-generation operating systems. The kernel of conventional operating systems is mainly responsible for managing and scheduling the system's hardware resources like GPU and memory to ensure normal operation and efficient utilization of system. Yet with increasing user demand, AI systems need to parse many human-related personalized experiences.

For personal knowledge base, people's location and status awareness, people's habits and hobbies and other personalization factors, conventional operating systems fall short of effective calculation and processing. We thus need a brand-new kernel to meet these requirements. The strength of platform-level AI foundation models is that they can manage and process multiple personal factors and help the operating system accurately recognize user intents. With such capabilities, fire-new operating systems can bring everyone an intelligent experience of “guess what you want and understand what you need.”

In automotive cockpit applications, to achieve true personalization, automakers also need to further customize the AI foundation model according to the features of their own vehicle models and services, that is, AI Agent based on platform-level AI foundation model. We can see that Geely models (such as Jiyue and Galaxy) are based on Baidu ERNIE Bot-based cockpit systems, and Mercedes-Benz's in-car voice assistant are actually an AI Agent after being connected to ChatGPT.

AI Agent will have a disruptive impact on the development and application of intelligent cockpit and intelligent driving

At present, intelligent driving AI Agent and cockpit AI Agent are separate. As cockpit-driving integration develops, they will tend to be integrated. However when considering cockpit-driving integration, OEMs and Tier1s cannot only consider integration at the hardware level, but also need to take into account operating system and vehicle system architecture, especially rapid evolution of foundation models/AI Agent models.

Foundation model/AI Agent is currently a part of an operating system/APP ecosystem. Will it replace operating systems/APP models in the future? We think it's possible.

Foundation model-based agents will not only allow everyone to have an exclusive intelligent assistant with enhanced capabilities, but also change the mode of human-machine cooperation and bring broader human-machine fusion. There are three human-AI cooperation modes: Embedding, Copilot, and Agent.

In intelligent driving, the Embedding mode is equivalent to L1-L2 autonomous driving; the Copilot mode, L2.5 and highway NOA; the Agent mode, urban NOA and L3 autonomous driving.

In the Agent mode, humans set goals and provide necessary resources (e.g., computing power), then AI independently undertakes most of tasks, and finally humans supervise the process and evaluate the final results. In this mode, AI fully embodies the interactive, autonomous and adaptable characteristics of Agents and is close to an independent actor, while humans play more of a supervisor and evaluator role.

A large number of interactive operations that were originally enabled via IVI APP can now be achieved through natural interactions (voice, gesture, etc.) in the AI Agent mode. AI Agent even actively observes the inside and outside of the vehicle, makes a request inquiry, and can perform a task after being confirmed by the user.

Therefore, the development of AI Agent is bound to make a mass of previous apps unnecessary and will have a disruptive impact on the development and application of intelligent cockpit and intelligent driving.

AI foundation models are likely to be combined with OS to become AIOS

The current AI foundation models are not an operating system, but a paradigm and architecture of AI models, focusing on how to enable machines to process multimodal data (text, image, video, etc.). AI Agent is more similar to an AI application or application layer, which requires the support of the underlying operating system and hardware for operation. It is not in itself responsible for the basic management and resource scheduling of the computer system. In the future, AI foundation models are likely to be combined with OS to become AIOS.

AI foundation models and AI Agent development have the following impacts on future operating systems:
Applets will disappear or evolve into AI Agent that calls foundation models;

OS may evolve into the foundation model + computing chip core cluster OS architecture;

AI foundation models as a platform redefine and empower all kinds of industrial application scenarios, and give rise to more human-computer interaction-centric native applications, including autonomous vehicles, robots and digital twin applications.

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