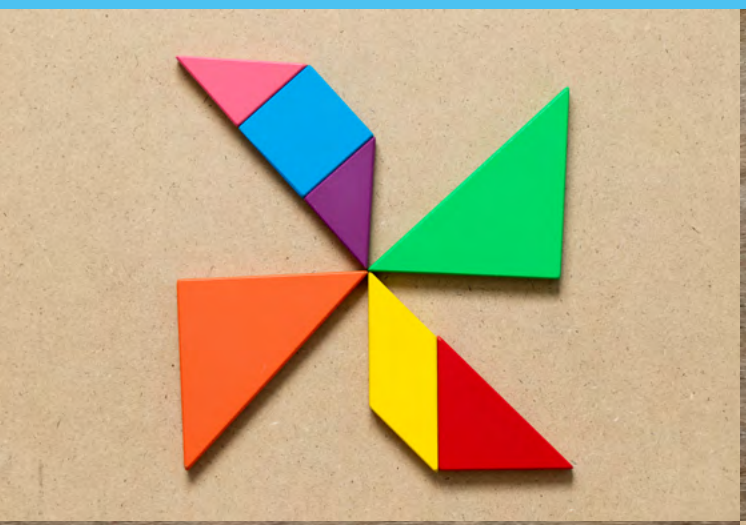
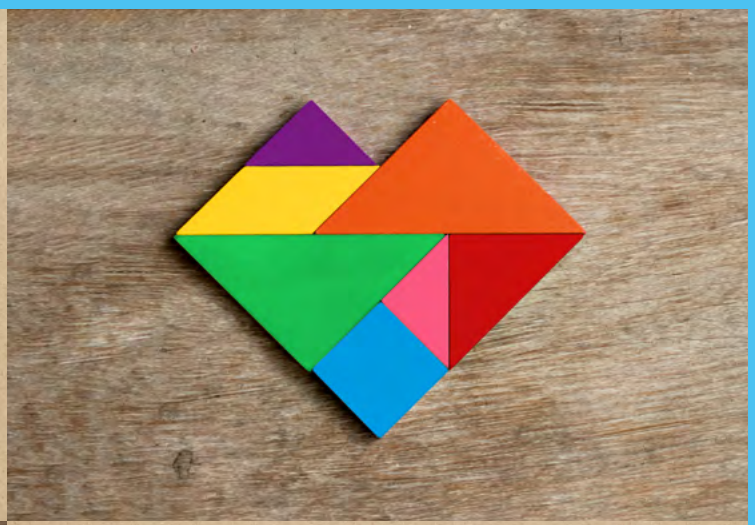
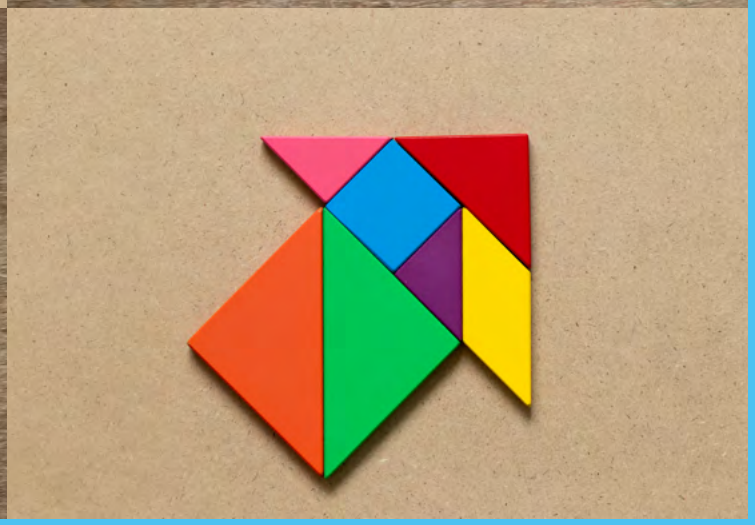
inware

The IAV magazine about software







Open Source

Interview

Michael Plagge on open source in the automotive industry.

Time booster

An AUTOSAR tool-chain from IAV saves 90 percent of the effort.

Smart and flexible

Grid-side charging control helps avoid bottle-necks in e-vehicle fleets.

Dear readers,

Automotive systems are increasingly based on software-driven performance and services. This increases the complexity that developers face. At the same time, there are not enough software developers to master all the challenges currently facing us – for example, in autonomous driving or electromobility.

That's why leading automotive manufacturers and suppliers, as well as other embedded industries, are becoming increasingly open to open-source software for use in vehicle development. This is where open-source communities and foundations come in, providing companies with a business-friendly environment for open source software collaboration. The Eclipse Foundation is one of the best known, and its goal is to provide a platform on which software can be developed through transparent collaboration.

Michael Plagge, Vice President Ecosystem Development at the Eclipse Foundation, in an interview about how the automotive industry could benefit from open-source platforms (page 8).

The fact that cooperation will become increasingly important in the future is also demonstrated by the "AI in the Loop" project, on which DLR, Mittweida University of Applied Sciences and IAV are working together. Prof. Dr. Frank Köster, founding director of the DLR Institute for AI Security, explains in an interview how AI-based software products can be developed in an agile manner in the future (page 32).

On page 41, you can read how the smartphone application "WonderVision" could safely navigate people with visual impairments to their destination.

We wish you an inspiring read!

Dr. Uwe Horn
President, CHRO

Matthias Kratzsch
President, CEO

Katja Ziegler
President, CFO

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Michael Plagge, Vice President Ecosystem Development at the Eclipse Foundation, on possible uses of open source in automotive development.

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Hard to believe: It takes two days instead of six weeks for an IAV toolchain to create Autosar documents describing a software architecture.

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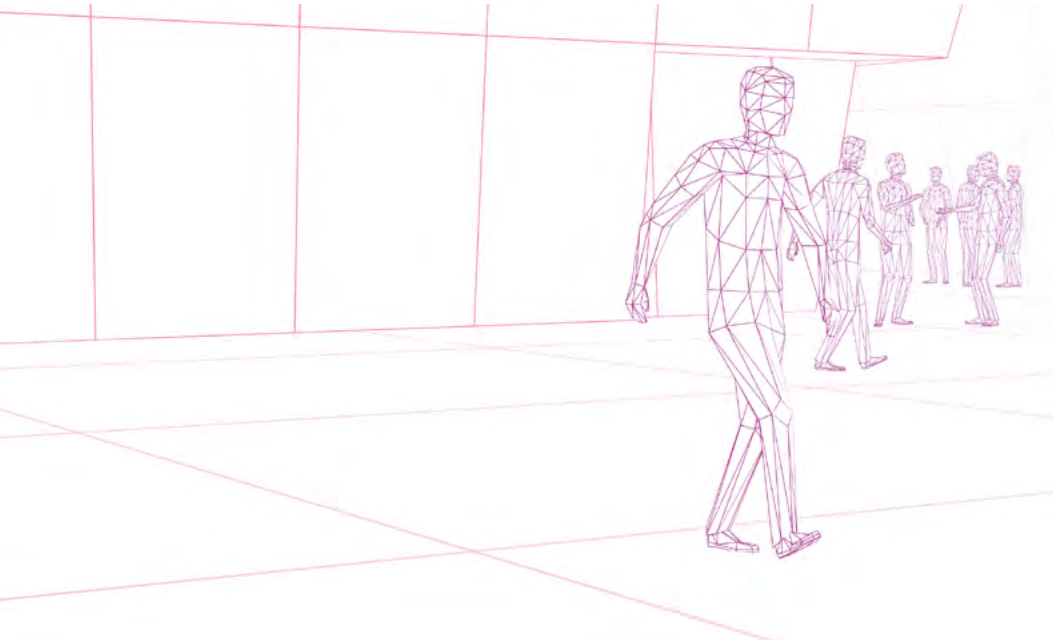
An AI from IAV recognizes the degree of ripeness of strawberries and harvests them precisely 24/7 by robot.



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AI is much more than fiction
DLR, Mittweida University of Applied Sciences and IAV are working together to develop AI-based software products in an agile manner in the future. Prof. Dr. Frank Köster from the DLR Institute for AI Safety, says why the project is so important.

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Teaser
New ways for the blind
An IAV technology solution opens up completely new possibilities for the visually impaired.

Bits & Bytes

Trust

© Robert Gortana / Flickr

is necessary to entrust one's life to an autonomous car, an artificial intelligence (AI) on four wheels. Intelligent machines, however, trigger fears in many people; surveys show a low level of trust in AI.

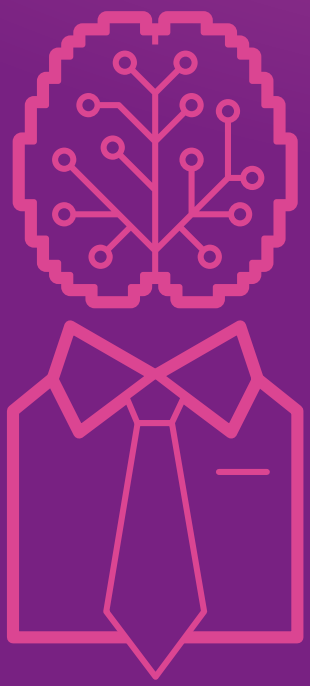
Martina Mara, a robot psychologist, would therefore like to see trustworthy, responsible AI "made in Europe" that is based on ethical values such as fairness, and recommends more education about the opportunities and risks of AI: In this way, instead of fear arising from ignorance or "overtrust," an overestimation of technology, a healthy middle ground can be found: "informed trust."

AI as CEO

Hong Kong software company Fujian Netdragon Websoft has had an AI as CEO since August 2022. She has learned to make management decisions, conduct analysis, assess risks, and organize workflows efficiently.

She does this so well that the parent company is highly satisfied with the virtual boss's work. Apparently with good reason, because compared to other companies with human leadership, the AI-led company did well. It posted an 18.2 percent share gain.

In a press release from Netdragon Websoft Holdings, Dr. Dejian Liu, chairman of the parent company, said, "Tang Yu represents our commitment to truly leverage the use of AI to transform the way we do business and ultimately drive our future strategic growth."



This is the @ character in Morse code. It was added to Morse code in 2004 as the first new character in 60 years. On the 160th anniversary, the International Telecom Union (ITU) decided on this update. Up to now, Morse code senders had made do with the word “at”.

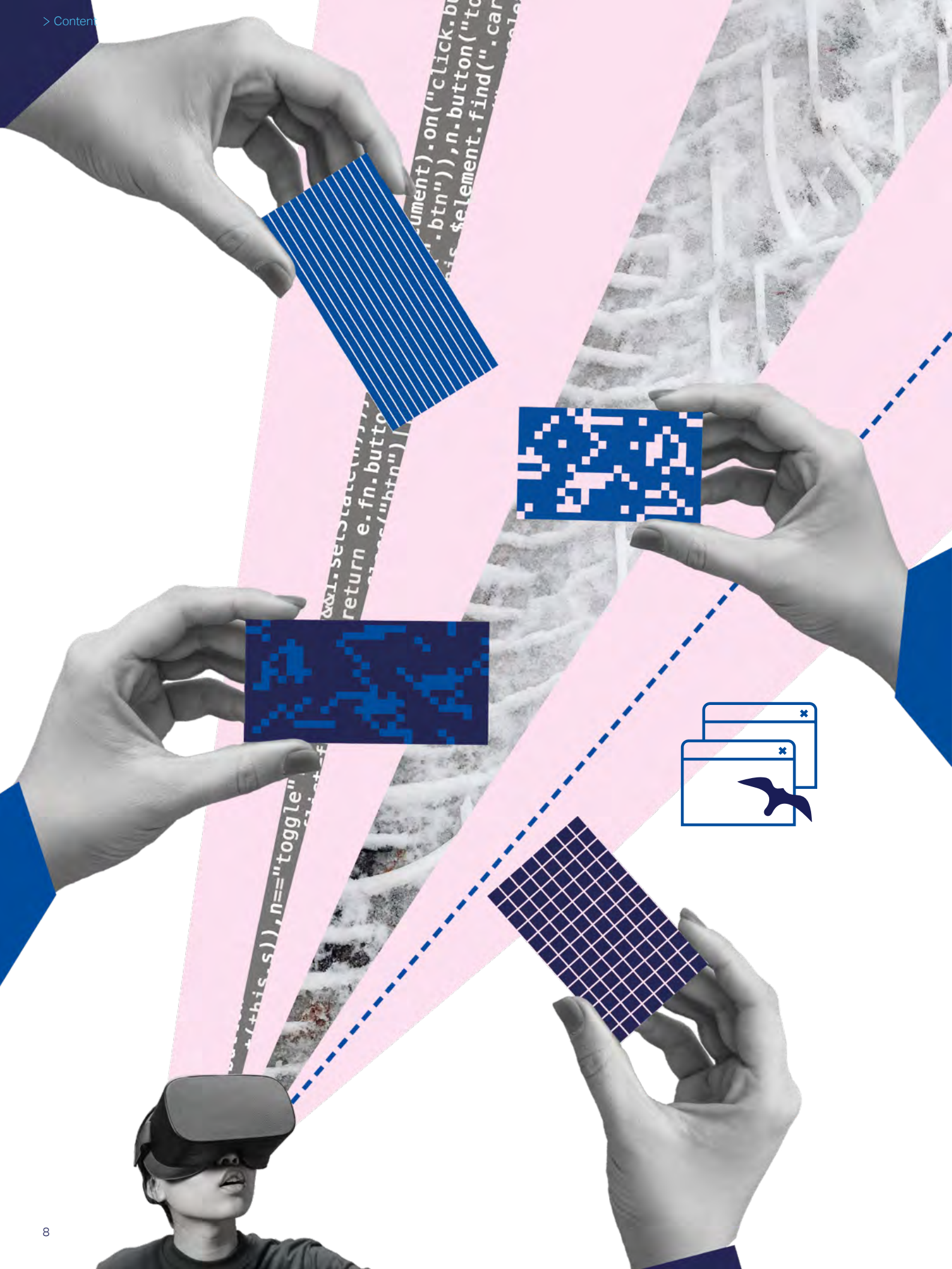
The @ character was chosen by programmers around 1971 as the reference character for the first e-mail client. Probably because it was present on the first computer keyboards, but without known meaning or significance.

The first computers were women

© Kenneth Martin / Flickr

Profession: calculator, in English: computer. This was the name given in the 1940s to employees of the U.S. Army who calculated ballistic tables for the trajectories of projectiles in complex equations.

Most of these employees were female. Like the six women who, starting in 1946, programmed the world’s first universal computer, ENIAC (Electronic Numerical Integrator and Computer): Jean Jennings, Betty Snyder, Ruth Lichterman, Marlyn Wescoff, Frances Bilas and Kay McNulty.



“Together we have the opportunity to define the future of the automotive industry”

The automotive industry is undergoing profound change. Open-source communities can play a major role in the future of the car. Michael Plagge, Vice President Ecosystem Development at Eclipse Foundation Europe, estimates which one might be exactly.

Michael Plagge has been Vice President Ecosystem Development at the Eclipse Foundation since January 2021. He is responsible for the further development of the Eclipse ecosystem, especially in the DACH region. Before joining the Eclipse Foundation, he spent four years in various positions at the Alibaba Group. In the eight years prior to that, Michael Plagge was employed by automotive supplier Elektrobit, where he was General Manager at Elektrobit Automotive (Shanghai) Ltd. from 2013 to 2016.

What does the Eclipse Foundation do? What is its aim?

Michael Plagge: The Eclipse Foundation is a non-profit association funded by its members. The aim of the Eclipse Foundation is to provide a home for businesses and communities and to implement open source projects under a non-profit visor. They have been around for 18 years, of which we have been registered in the USA for 16 years. Recently, however, we moved to Europe because the majority of our members are from Europe and we saw the need for a large open source foundation here.

Why are open source projects so important today?

Collaboration in the development of cloud and AI technologies has shown that they can be beneficial because they can quickly reach the non-competitive space. As soon as there is a common basis for all parties involved, a technology can be implemented in a wide range of areas, such as the automotive industry. In addition, today there are highly verticalized software developments and tool chains that are difficult to transfer from one to the other.

Collaboration platforms make it possible in the non-competitive area to becomefocused on the value-added parts of the software chain. Here is a concrete example: At TensorFlow or pyTorch, the entire software world has agreed that there are accessible frameworks based on which one can work on algorithms without having to implement complex frameworks in advance. This allows you to focus on the area you want to develop further.

Does the automotive industry need more open source?

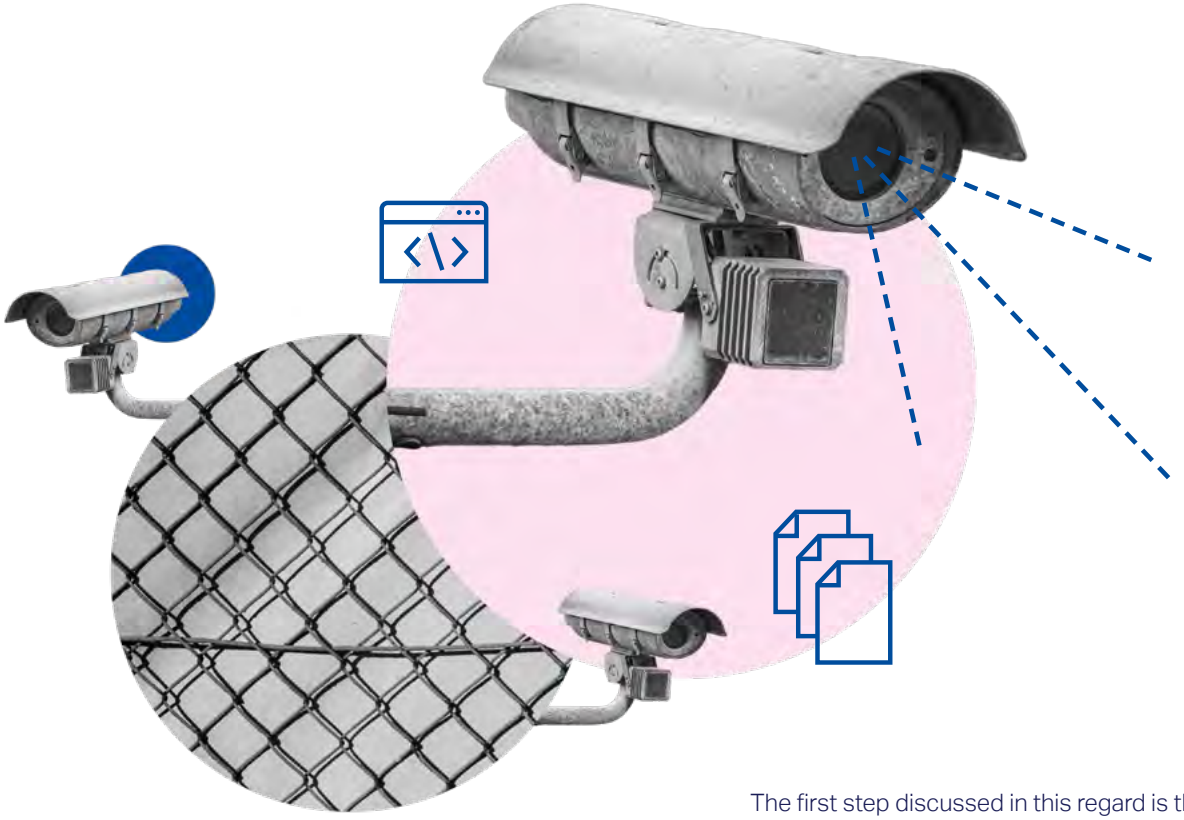
Software has been very successful in the automotive industry over the past 30 years. But the software competence that has been built up in the field of safety in the automotive sector has become a hygiene factor today. On the other hand, features that make customers buy cars today have been partially neglected.

I see two challenges here: First, the features have to be developed themselves if the industry does not want to resort to offers from Google or Apple. Secondly, there are not enough developers available, so we need to be more effective.

Therefore, it would make sense to build common platforms that are widely used and software that is needed everywhere – such as Middleware – to develop together as an industry. The competitive parts could then be implemented in-house by the individual companies using the available resources.

What could the cooperation on open source projects in the automotive sector look like?

The automotive industry is known to be very competitive. But a model such as open source and a non-competitive collaboration platform can enable collaboration. The Eclipse Foundation has a process model that is described in detail, which shows how the collaboration can take place and how decisions can be made. This helps many companies within an industry.

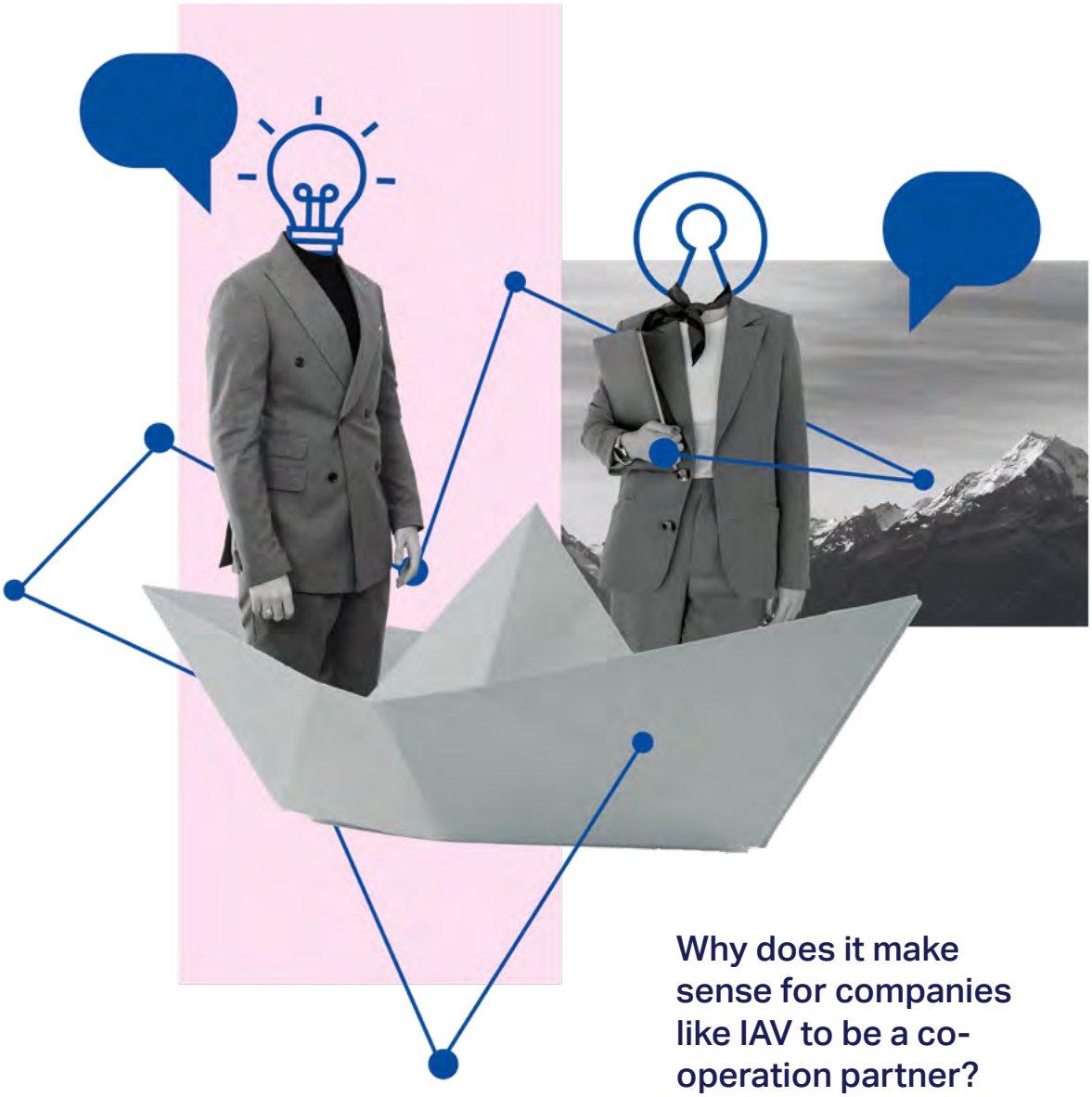


What does the Eclipse Foundation do in software security?

The issue of software supply chain security is important to us. Open source does not work anarchic, but is a collaboration model that relies on consensus and constructive support. As a result, participants with "not always sympathetic" intentions can have an impact. So, we need to protect the software supply chain.

The first step discussed in this regard is the "Software Bill of Materials" (SBOM). That means that for each software it is known which components are finally included. For explanation, open source components usually build on existing open source components. This can lead to security vulnerabilities remaining undetected because you do not know which components are in the software in detail. A well-known example of such a vulnerability is Java Log4j. The software was vulnerable and stuck in millions of projects. This shows why we need more transparency.

For this reason, the Eclipse Foundation offers further mechanisms and competencies in the area of software supply chain security to make the final software as secure as possible. This is particularly important in the automotive industry, as European legislation places requirements on safety and cyber security.



Why does it make sense for companies like IAV to be a co-operation partner?

I believe that together we have the chance to see the future of the software stack in the car, in the cloud and in the tool chain in the automotive industry. Especially for the experts, so that companies such as IAV, which already have a high level of competence in the areas of integration of certain software components, can be very interesting to bring in these competences. Because those who participate can bring their own interests.

Many existing business models are at risk due to the profound changes in the automotive industry, especially in the area of software. However, what the community does in the Eclipse SDV Working Group will be the basis for many new business models in the future.

In the traditional automotive industry, overhead has crept into the complexity of software development. In the past, all car manufacturers had the same complexity, so there was no competitive pressure. This has changed after new entrants such as Tesla or Chinese OEMs have come to market and have shown that software development can be much more efficient.

So, the question is how to deal with pressure. Our initiative is an answer to this. Companies such as IAV, which have been well positioned in the software sector for decades, can see it as an opportunity to open up new business fields and establish new business models.

What can IAV make in concrete terms?

I would be very pleased if IAV introduces software components that it believes can be a valuable part of a future open source stack. It is at least as interesting for IAV to participate in one of the existing projects. Because so far, we have 15 projects, but each of them comes from a single company. In the medium term, we want the projects to be more broadly structured and to work together with representatives from different companies. This would also have the advantage that exchange within the projects would be much more open and more often communicated to the outside.

I see companies like IAV as the lead to build a distribution across these projects. After all, we want to offer a solution for a series developer. This stack must be off various projects. In addition, I could imagine that IAV can contribute its many years of experience in the automotive sector at the process and integration level.

"The opportunity for the Eclipse Foundation is to leverage synergies and democratize the software industry. In the automotive sector, are not enough developers to meet the current challenges, i.e. in the area of e-mobility or when driving autonomously.

For IAV, membership in the Eclipse Foundation means two things: On the one hand, we look forward to the valuable input of the community, and on the other hand, we plan to contribute our expertise. Especially in the field of vehicle software, and tooling, we can support the members with massive expertise. I am confident that we can bring in software components that are of great benefit to the community. That is why I am looking forward to the upcoming member meetings of the SDV Working Group." Andre Larberg

Andre Larberg, Senior Technical Consultant Open Source at IAV

Contact
andre.larberg@iav.de
markus.blonn@iav.de

What is the value of mobility?

The classic automotive industry and the digital world operate according to different, sometimes contradictory principles. Jürgen Müller, software manager at the development service provider IAV, therefore sees himself as a translator and bridge-builder between the systems. In the interview, he describes what car manufacturers can learn from the IT industry and what is important to be able to turn bits and bytes into new business models.

Digital services are already shaping the car today and are becoming increasingly important. What does this mean for OEMs?

Jürgen Müller: The car is an attractive space for different companies: They have almost undivided attention there and can fill the time in the vehicle with their offers. Google offers infotainment in the car with its Android operating system and services such as Google Automotive Services – abbreviated as „GAS" – Apple brings its HMI, its user interface, with CarPlay, and Amazon is also looking for a way into the vehicle.

In direct competition, it will be difficult for OEMs to compete against these players. It is conceivable that hybrid solutions will emerge in which manufacturers will leave certain functions to the tech companies but control their brand-defining features themselves – these are certainly different in a luxury vehicle than in the mass market.

What can the classic automotive industry learn from the IT industry?

Manufacturers must understand and treat their central product – the car – as a software-defined product. They must coordinate their entire world, including their infrastructure, with this. This applies, for example, to update and upgrade capabilities, which are part of „client management" in the IT world.

The industry must deal with the character of the incompletion and align its functions to allow functions to be developed further, that they can be changed – and that changes outside the product do not lead to failures.

This then also includes the topic of cybersecurity?

Exactly. In IT development, cybersecurity is the center of every system, and it is considered in the design from the very beginning of the development. In my view, this is the next big step that the automotive industry can learn from IT.

At IAV, we have been focusing on this area for years and are constantly developing it, with our Automotive Cyber Defence Center (ACDC) at the heart of it.

What other IT trends are becoming important for the automotive industry?

Work with standards. This is an essential prerequisite for being able to develop new products faster. In IT, quasi-standards are often formed by the proliferation of applications, which are often continually improved as an open-source model. This was the case, for example, with Docker or, at present, with Kubernetes, systems for so-called container infrastructures.

Not everything in the car can be tackled in this way, but I assume that we will see more and more such standards in the development of vehicles as well.

Manufacturers can use our expertise to look at new technologies. As developers, we naturally have a very broad portfolio and are not committed to specific technologies.

With digitization, the amount of data around the car is increasing. The industry has already created a European platform for the controlled exchange of data, Catena-X. How critical is data to future business success?

The interesting question is: What successful business models based on data have existed so far? Personalized advertising, accurate maps – but otherwise? Somehow, the cost of collecting and evaluating the data has to be calculated.

There are also possible benefits for the general public: For example, the prediction quality of heavy rain events can be improved if the data from rain sensors in cars is used. This was shown by a study* by IAV. So, if all manufacturers would provide the data of their rain sensors …

… then someone would also have to pay for it. Large amounts of data cost a lot of money. We will not be able to afford the deluge of data those modern systems produce, simply put it somewhere unconditionally and then at some point do anything with it.

The challenge is therefore to collect the relevant data and draw the right conclusions from it. This enables companies to differentiate themselves and develop their own offers, for example a heavy rain forecast. The crucial point is to think about the question of data from the end of monetization: What is the business model for which it can be used?

* iav.com/heavy-rain-forecast

Jürgen Müller, Executive Vice President, Connected Software Systems & Services at IAV

IAV currently relies heavily on services for software. What does this mean?

Services are a kind of bridge between the digital and physical world. For example, we offer analysis services and services for electric vehicle fleets, for example for charging management. Or our cybersecurity center.

Such services must work for different customers, large and small fleets, and different IT systems. For us, this means a high commitment, for example, in terms of reliability.

The special thing is that we develop many of these services together with a customer. This gives the customer a tailored solution for his or her problem and the competitive advantage of being the first to work with it. We get new expertise that we can use for further customers – a win-win situation. And then everyone, new and established customers, can benefit from the further developments.

Will digitalization make the car more and more a much-quoted „smartphone on wheels"?

I do not like the expression very much. A car is not a telephone, it is supposed to bring people and things from A to B, that is its basic characteristic. This requires functional safety and must comply with legal requirements. This will continue to be the case in the future.

I see the car more as a technical platform with a backend share, a leased line to the cloud. This interplay opens up new possibilities for mobility concepts. In this, the car is a networked system component.

The challenge is that there is still no good model for calculating the value of mobility. Sometimes it is important to get to your destination as quickly as possible, sometimes time plays a lesser role and quality matters more – comfort or a beautiful route, for example.

In addition, manufacturers are now offering „emotional" features, such as a car color that adapts to the mood of the driver.

It is our nature to humanize things. The style that is important differs considerably in the regions of the world, as it will depend on a high degree of flexibility to adapt such features.

Can such a thing also work in sober Germany?

I think so. If, for example, the car windows are used as screens, this gives new possibilities for the design of the interior, making it more homely. This can create real added value and increase the quality of mobility. And then customers pay for it.

Contact
juergen.mueller@iav.de

For sustainable electricity grids

The electricity grid in Germany must adapt to the requirements of the energy transition. In concrete terms, this means a demand-based expansion and continuous further development of grid operations. As part of two research projects, IAV has developed intelligent solutions with partners, by which the performance of the existing infrastructure can be optimized in a targeted manner, e-mobility can be integrated, and network expansion can be kept on a manageable scale.

Supported by:

Federal Ministry
for Economic Affairs
and Climate Action

on the basis of a decision
by the German Bundestag

Bring power networks to the forefront

Intelligent power network planning in the age of energy transition and e-mobility? The funding project "SpaZiel" currently shows how smart technologies can be used to optimize distribution networks for future requirements and how voltage levels can be analyzed comprehensively.

The power network must compensate for fluctuations and ensure reliable supply even during peak times. The key here is the ability of the network to compensate for locally changing generation and load situations – efficient target network planning is essential for this.

Due to constantly increasing requirements on distribution networks because of new loads (e.g. electric cars) and feed-in systems (e.g. PV systems), manual processes for network and expansion planning are increasingly reaching their limits.

As part of the three-year research project "SpaZiel" (cross-voltage and automated target network planning), IAV, the Bergische Universität Wuppertal (BUW) and associated partners want to develop a software-supported methodology by 2025 at the latest, whereby distribution networks can be planned automatically, and necessary conversion measures can be calculated. The aim is to combine existing software tools for automated network planning for the areas of medium voltage (IAV Optera) and low voltage (BUW).

"The challenges of the energy transition can only be handled through digitization methods and well-thought-out and professional automation," says Michael Schollmeyer, coordinator of energy systems at IAV.

"Possible bottlenecks, such as available material and skilled workers, make automated and high-quality network planning indispensable. This allows us to identify exactly where the greatest impact can be achieved," says Schollmeyer.

For example, as with IAV Optera, geostructure and available market data will be integrated into the development of the new software methodology. In addition to exploiting economic and technical synergies, it is also important to identify where unnecessary and expensive network expansion measures can be postponed or avoided altogether.

Expanding renewable energies and reducing dependency on fossil fuels are the core goals of the energy transition. The "SpaZiel" research project, funded by federal funds, makes a relevant contribution to the climate-friendly changeover of our energy supply.

More information about IAV Optera: iav.com/en/services/iav-optera

Contact
michael.schollmeyer@iav.de
felix.nolteernsting@iav.de

How to speak with charging stations

Utilizing power networks more evenly with intelligent and flexible charging control of electric vehicle fleets. This not only avoids bottlenecks in the power supply but can also lead to a cost reduction for consumers thanks to possible savings in network expansion.

When entire electric vehicle fleets, for example from delivery or supply services, are charged overnight with high peak loads, this poses considerable challenges to distribution system operators. One possible risk is that supply and demand for renewable energies will get out of balance at peak times without smart network planning – and charging operations will not be fully carried out.

To prevent this, a dynamic, network-side control system for charging was developed as part of the federal-funded research project „Netz_eLOG" (Intelligent Grid Integration of Electrified Logistics). A consortium of Reiner Lemoine Institute, E.DIS Netz GmbH and IAV investigated at a distribution center of Deutsche Post DHL Group the flexibility potential offered by e-mobility for the power network and how these possibilities can be used in a network-friendly and transparent manner.

„In view of the increasing, volatile feed-in of renewable energies, the use of flexibility is becoming increasingly important for the power network," explains Lola Wybieralski, Software Requirements Analyst at IAV. „Standardized, network-friendly controllability and the advance planning of the e-mobility in the distribution network would significantly increase the planning security of the operators."

IoT platform for tailored communication

As a project partner, IAV has developed an IoT platform that enables the interoperable communication of the systems anchored in the project. The company has taken into account all requirements of distribution network and fleet operators and implemented an ideal control model for optimum charging of the logistics fleet by means of a software-as-a-service application. Future values from forecasts and knowledge from past charging behavior have been incorporated.

Supported by:

Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit

on the basis of a decision by the German Bundestag

For IAV, the challenge was to provide a completely new load management software during the ongoing operation of the Post without affecting the operations of the logistics group. To minimize any risk, IAV engineers had set up a quality assurance environment at the development center in Gifhorn in advance to test the software modules.

Thanks to the stable software architecture, an undisturbed operation of the DHL site was possible throughout and the essential measurement data in the e-mobility and buildings area could be securely transmitted and visualized via front end. This provided the charging control and individual settings.

Websockets were used for data transfer between charging stations and backend. The interfaces for control commands from the network operator were provided via MQTT. Information from the site consumption was transmitted via HTTPS through installed measuring devices on the building. The process and format of the message transmission to the charging station were defined via open charge point protocol (OCPP).

More flexibility, lower costs

During the three-year duration (2019-2022) of project „Netz_eLOG“, four strategies were developed and successfully tested, and their effects on the location were precisely analyzed.

It is now possible to reduce the peak load by up to 50 percent by adjusting the charging strategy, resulting in immediate cost reductions for consumers. Thanks to intelligent steering, network expansion can be avoided even with a growing fleet of vehicles, thus also saving costs for electricity network operators.

The power of the charging stations can also be completely restricted by means of a control system or booted up to maximum level – depending on the available electrical energy in the network. For network operators, tests of high-load windows also revealed valuable conclusions regarding flexibility.

„We have integrated the logistics criteria of the fleet operator and the requirements of the network operator into the charging control system," says Frank Maerzke, Team Manager EV-Fleet Services at IAV. „This is the first time that these two data streams merge into one system – a real turning point."

Contact
frank.maerzke@iav.de
lola.wybieralski@iav.de

A UN/ECE regulation has imposed new cybersecurity requirements on new vehicle models since mid-2022. In the future, no vehicle will be allowed on the road unless the manufacturer can prove that the vehicle series was developed to be cybersecure. IAV helps OEMs and suppliers address the new requirements and processes.

First, the air conditioning system went to the highest level, followed by deafening rap music, and finally, as if by magic, the wiper system started. These were the most harmless surprises, Andy Greenberg, journalist for the U.S. magazine "WIRED" had to endure at the wheel of a Jeep Cherokee. Later, the accelerator pedal blocked in the middle of the highway, and thanks to the brakes turned off, he landed at the end of a nerve-wracking ride in the ditch next to a parking lot.

Greenberg owed his horror ride to two IT experts, Charlie Miller and Chris Valasek. They hacked into the Cherokee via the Internet and managed to access all vehicle features from their home living room via a laptop. This was made possible by a security vulnerability in the infotainment system of the jeep, through which unauthorized "CAN" messages (Controller Area Network) could be sent to air conditioning system, engine and brakes.

"This campaign made headlines worldwide in 2016," recalls Hauke Petersen, Senior Technical Consultant Automotive Security at IAV. "It was also a wake-up call for car manufacturers and has led to a much stronger awareness of cybersecurity."

Stop hackers

Increasingly larger attack surfaces

Since then, however, the network of vehicles has continued to increase – and thus the number of possible attack scenarios: Hackers can now attempt to manipulate a vehicle via mobile communications, Bluetooth, near-field communication (NFC), WLAN or Car2X connections, among others.

"In addition, the IT architecture of modern cars is increasingly changing toward centralization," explains Carsten Elvers, Head of Department Embedded Security at IAV. "There, more and more components from the PC and Internet area are being used, which makes life even easier for the attackers."

To protect vehicles better from hackers, the UN/ECE Economic Commission for Europe has developed a new control on Cybersecurity (R155), which sets the requirements for new vehicle types and from 2024 for all new cars. Detailed processes for vehicle development are provided in ISO/SAE Standard 21434 ("Road Vehicles – Cybersecurity Engineering"). For example, in the future, OEMs will have to prove that they have a cybersecurity management process and that they are able to develop vehicles safely in cybersecurity terms.

Cat-and-mouse game

"We know the cat-and-mouse game with the hackers because we have been developing safety-relevant software such as immobilizers for 20 years," says Petersen. Therefore, IAV can offer vehicle manufacturers advice on the new requirements and support in providing the required documentation along the entire V process.

For large OEMs, the focus is on the documentation and implementation of the processes; for smaller manufacturers, advice on the consequences of the new regulations is currently required. "But Tier 1 suppliers must also become cyber-compliant," says Elvers. "We can also support this – after all, we are in the process of adapting all processes to the new requirements ourselves."

The aim is to make connected vehicles safer and thus to offer hackers such as Miller and Valasek fewer opportunities to attack in the future.

Contact
hauke.petersen@iav.de
carsten.elvers@iav.de

Existing vehicles lose type approval

The new regulations have been in force since July 2022 for the type-approval of new vehicles. But the stock types are also affected: From July 2024, the existing type approvals will no longer apply. New vehicles in the UN/ECE area – essentially the European Union, Russia, South Korea, Japan, South Africa and Australia – may no longer be sold without proof that they meet the requirements of the new regulations.

OEMs will therefore have to analyze possible attack scenarios in security analyzes by the middle of next year, for example, and derive security objectives and requirements from them – such as the encryption and signing of communication between control units. These vehicles are then kept up to date with the latest safety status via a software update.

Software blueprint via keystroke

The more functions are combined in automotive control units, the more difficult and complex is their integration. A new IAV platform allows for the inclusion to be carried out by suppliers in two days – completely unique in the market. The next step is to roll out the tool as a web service.

Two days instead of six weeks

Fewer control units distributed across the vehicle, instead central computers with high computing power: This is what the IT architecture in the car will look like in the future. For example, this allows a central domain controller to take over many functions from the powertrain and chassis sectors, replacing a small two-digit number of conventional control units. This is based on powerful multi-core microprocessors and real-time operating systems that enable multitasking.

Many suppliers contribute individual functions that later run on the domain controller. Some of them need input values, for example wheel drive and speed while others need to store data, for instance for documenting emission values. The software architecture must ensure that all information is reliably distributed to the individual functions.

"We have to take this into account during the development," explains Stephan Reichelt, Head of Department Vehicle Software Solutions at IAV. "It's very similar to building a house: one has to place pipes and cable correctly when planning, so that water, electricity and data can flow later."

Software developers use AUTOSAR (Automotive Open System Architecture), a version of the XML description language that is specifically adapted to the needs of the automotive industry. Extensive documents illustrate, among other things, which functions exist, which interfaces they connect, how quickly certain functions must be executed and how they should be separated from each other. A powerful domain controller quickly brings together more than 100 megabytes of pure text that developers must create manually. This can take four to six weeks and will need to be tackled again for each new software integration level.

To reduce this effort significantly, IAV has developed an AUTOSAR tool chain for a customer. It relieves engineers of the manual work involved in the creation of AUTOSAR documents and reduces the processing time from several weeks to just two days. "We are reducing the effort by over 90 percent," estimates Reichelt. In the first step, the tool receives the information provided by the suppliers on the individual functions. Typical formats are text documents, Excel files, CSV files or other AUTOSAR documents. The tool can also be adapted to other formats.

This is followed by a check of the input data: Which functions talk to each other? In what format must the data be transferred? Are the desired data available? If the tool detects a problem here, it will be reported immediately and can be corrected within a short period of time. In the next step, the input data is transferred to a special model and stored in a database. "We store the input data in versioned form," reports Reichelt. "The model enables data separation and integration, so that one can work on two variants in parallel and merge them later." In addition, customer-specific features can be stored directly in the data model via an expansion interface. In the end, the IAV tool automatically generates an AUTOSAR document that describes the software architecture – in any output format.

Web-based platform planned

Since 2020, the new tool has been in use and has exceeded the expectations of the customer. "On the one hand, it is to be used for another control unit, on the other hand, there are also requests for the new solution from other departments of our customer," says Reichelt. "No wonder: Our tool is unique, there is nothing comparable on the market."

IAV is currently developing the tool further: In the future it will be available as a web-based platform, so that all parties involved can upload new documents about their functions at any time. New AUTOSAR documents could then even be generated within a few hours. Independently of this, IAV is working on providing additional tools for the AUTOSAR development process as part of its own development.

Contact
stephan.reichelt@iav.de
kai.feuerstake@iav.de

Ready for the robot

Using artificial intelligence (AI) to determine the maturity of strawberries and harvest the fruits precisely? The picking robot from IAV shows how technology and method know-how from the automotive industry can solve even the most demanding challenges of other industries.

When driving autonomously, precise environment and object recognition, as well as the interaction of cloud computing, camera and AI ("computer vision") are extremely important. The findings from the automotive application of these technologies can also be transferred to other areas, such as smart farming.

IAV has refined the methodology by which automotive expertise can be applied in agricultural technology, especially in the software sector, and has developed it especially for the application of automated strawberry harvesting. And the basics of "systems engineering" are applied in parallel in the development process.

AI algorithms were developed for fruit detection and dedicated data pipelines were set up to be able to train suitable models quickly, using high-performance computing (HPC). IAV uses its own structures to train and apply neural networks.

Automotive expertise for new industries

"We are developing technologies not only for our automotive customers, but also for ourselves, and we are independently deriving comprehensive solutions for other use cases," explains Enrico Neumann, Product Manager at IAV.

The strawberry-harvesting robot gives a perfect example. Thanks to in-house developments by IAV in the area of sensor technology, the mechanical harvester rolls completely autonomously through planting aisles, so-called stands. Equipped with a camera and a patented gripping system, the arm of the robot locates the strawberries via AI, categorizes them according to maturity and carefully separates the ripe fruits from the plant on the stem before laying them down safely.

For German strawberry farmers, this solution could be a stroke of luck. Rising wages and a chronic shortage of harvest workers, exacerbated by the effects of the coronavirus pandemic and the war in Ukraine, are driving the cost of the coveted fruit. The automated harvest helps to ensure that despite these challenges, strawberry cultivation in Germany continues to be possible in the future.

Competence for entire system

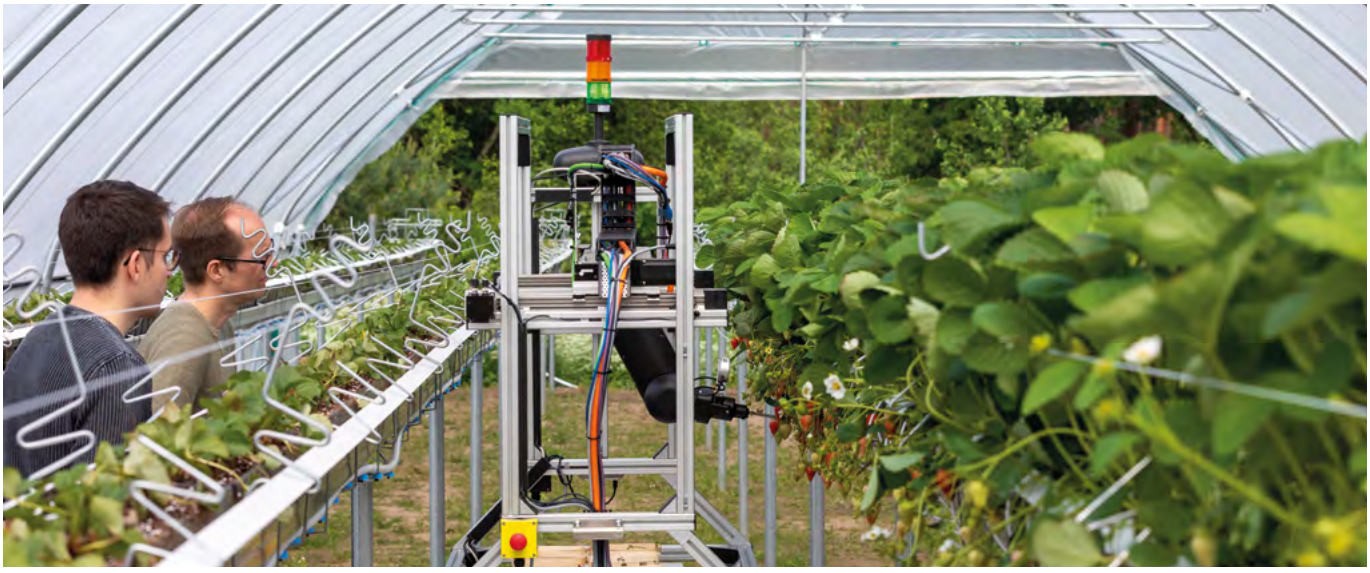
Unlike projects in the automotive sector, where existing infrastructures can often be used, this project is a completely new development, from the initial idea via simulation to hardware. The complex communication between different computers on board of each harvesting robot is based on the robot operating system (ROS) as middleware.

"This is a complete system that has emerged from nowhere," says Dr. Thimo Oehlschläegel, Team Manager Control Solutions at IAV. "We have systematically not only looked at the operation, but at all phases of the product lifecycle and have implemented all disciplines from hardware design to AI algorithms ourselves – the ultimate proof of our overall system competence."

Currently, the engineers have set up a new evolutionary stage of gripper arm technology. In accordance with model-based development, IAV is testing the desired degrees of freedom in advance in a realistic 3D environment and thus is preparing optimizations of the gripping strategy. The company relies on simulations ("Software-in-the-Loop"), with the help of which the gripper arm can be designed more precisely for its functions and the kinematics of the arm can better implement the tasks set via software. The robot, which can also be used at night, has so far successfully completed about four million cuts in endurance tests at over 4,000 operating hours of the gripper arm. From next year, there could be much more: Then IAV plans the market launch – in time for the 2024 harvest season.

Contact
enrico.neumann@iav.de
thimo.oehlschlaegel@iav.de

4.000
operating hours



4 mio. cuts

400.000 boxes

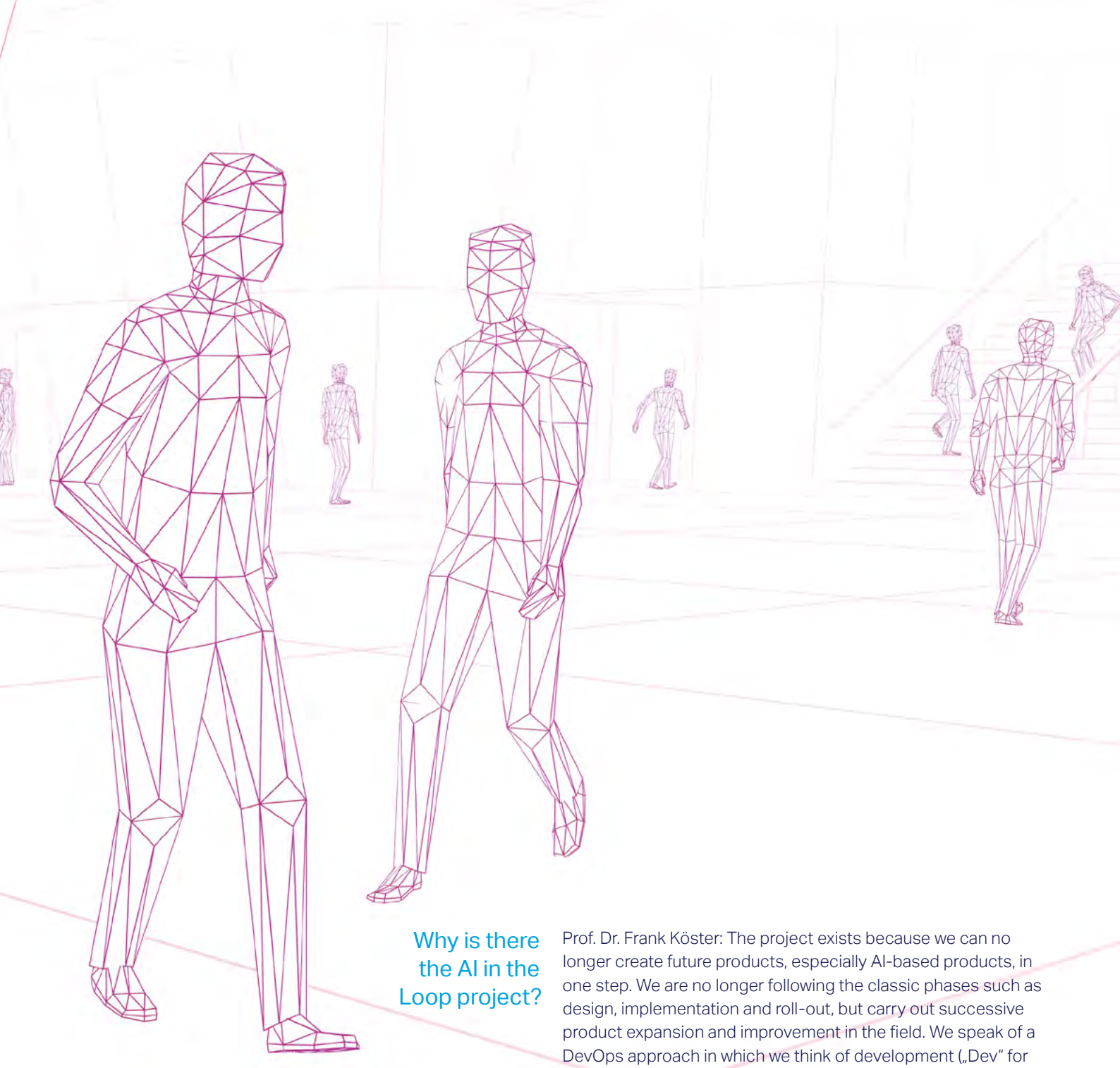
4 million cuts per 25 g of strawberries make 400,000 boxes à 250 g.

Harvesting robots in action: With the latest sensor technology autonomously on the move in planting aisles. The gripper arm locates the strawberries, classifies them according to ripeness and carefully separates the fruit.

AI is much more science than fiction

With the „AI in the Loop“ project, DLR, Mittweida University of Applied Sciences and IAV want to find jointly solutions for the agile development of AI-based software products in the future. AI algorithms are used because it is easier to optimize the software and people can better understand what an AI system is. In the interview Prof. Dr. Frank Köster, founding director of the DLR Institute for AI Security, explains why the project is important.

Prof. Dr. Frank Köster is founding director of the DLR Institute for AI Security, which was founded in 2020/2021. The institute deals with cross-sectional relevant basic research on artificial intelligence as well as application-oriented and practical developments.



Why is there the AI in the Loop project?

Prof. Dr. Frank Köster: The project exists because we can no longer create future products, especially AI-based products, in one step. We are no longer following the classic phases such as design, implementation and roll-out, but carry out successive product expansion and improvement in the field. We speak of a DevOps approach in which we think of development („Dev" for development) and operations („Ops" for operations) in an integrated way with the aim of continuous product improvement or -further development.

At the DLR Institute of AI Security, we particularly focus safety and security for AI-based solutions. Therefore, we focus on security-related issues in the „AI in the Loop" project.

We also need innovative methods to be able to carry out safety-oriented proofs for iterated system development and to address the topic of security substantially. The project is a vehicle for our research, which is why it is strategically important for us to set up and implement the laboratory in a practical manner.

What is the main objective of the project?

DLR wants to build the solutions so generically that we can apply them in different industrial domains. This will be done, for example, for applications in the fields of robotics, aviation and automotive. We want to apply the findings in practice in a timely manner. Therefore, it makes sense that we have partners who come from practice and do not view the project purely academically. The idea is also to continue the cooperation that is starting with the „AI in the Loop" laboratory setup in the longer term.

How far is the project? What can the robots already do?

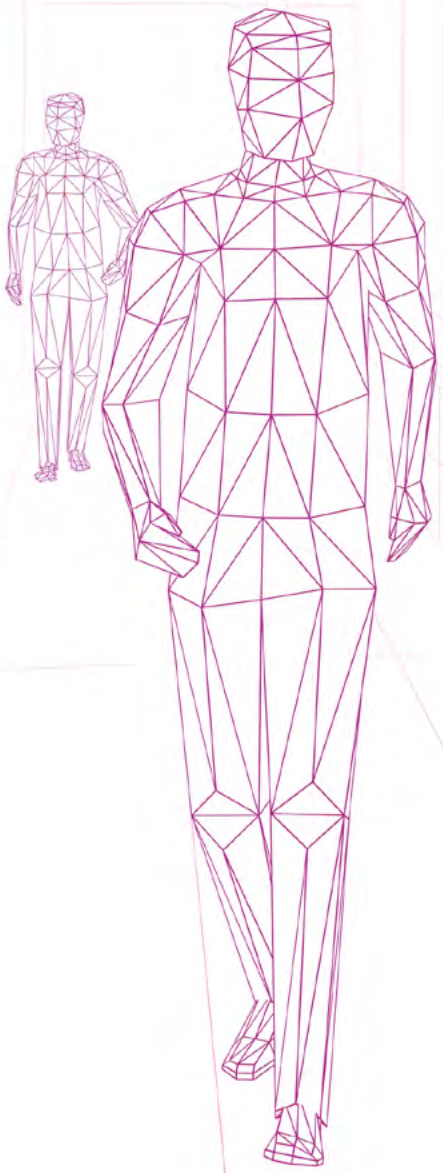
We can already take the first steps. The service robots are driving around DLR, picking up guests from the elevator, driving through a crowd and mastering initial interaction with people.

The development of service robots is not really our main topic, but they make it easier to understand what an AI system is. The robots are primarily there to make our work visible and tangible. In her physical form, we can see that the AI algorithms are not only relevant in science fiction films but are already very close to us today. So, it is not something that we will have to deal with in 20 years' time, but a subject that reaches us all relatively quickly.

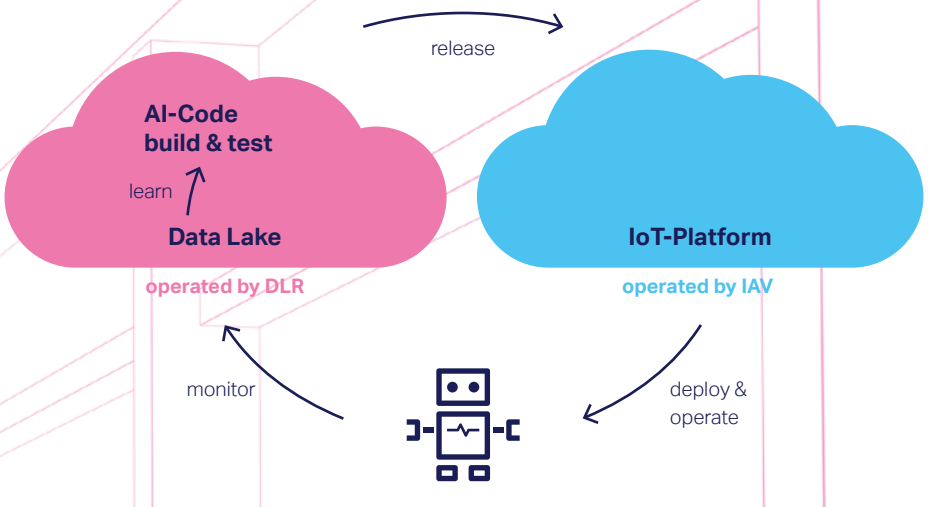
Do the robots recognize people they have seen before?

Not yet, but in the next step, it would be desirable for the robots to recognize people who are more frequent guests at the institute and start an interaction with them. You should also know, among other things, where the person is who the guests want to see.

The self-driving robots used in „AI in the loop" already drive up and down the hallways and can pick up guests from the elevator.



Building blocks of the DevOps cycle



How does AI work?

At AI, we have the ability to comprehensively process large amounts of data using intelligent algorithms. This is also a central functionality in the robots. For example, they should be able to perceive the environment with a camera, recognize the objects in it and classify them. They should also know how to interact with people and objects. It is important that future developments in the environment or in a system can be predicted.

To realize this, we use AI algorithms. AI-based components are absolutely necessary solution modules, especially in perception, i.e. in recognizing, interpreting and deriving actions.

What are the challenges?

It is a great challenge to project a deep technical or semantic level into technical systems. This means that a robot should recognize objects and people and understand exactly which object it has in front of it. They should know that a chair has fallen over, or a person is lying on the floor because they may have a health problem. We try to find out how we can elegantly combine technical algorithms and semantic information to reliably plan and initiate appropriate operations and actions.

A second challenge is to make the detection and algorithms robust meeregarding safety and security in order to be able to cushion attack scenarios. Currently, for example, a special pattern on a T-shirt could be used to prevent objects from being detected correctly: We need to find out what this potential for deception is and how it can be compensated by other sensors or data sources.

What can the technology be used for later?

The focus for us is the „AI in the Loop" laboratory as a tool. The technology becomes relevant for various robotic systems, but also in the field of automated flying and automated driving. The focus of the research will initially be on the perception component – i.e., on deriving environmental models and understanding situations.

Are there overlaps with other sciences?

In addition to the technology-oriented questions, we are also interested in ethical, legal, and societal questions, such as those that arise in a strong human-technology integration.

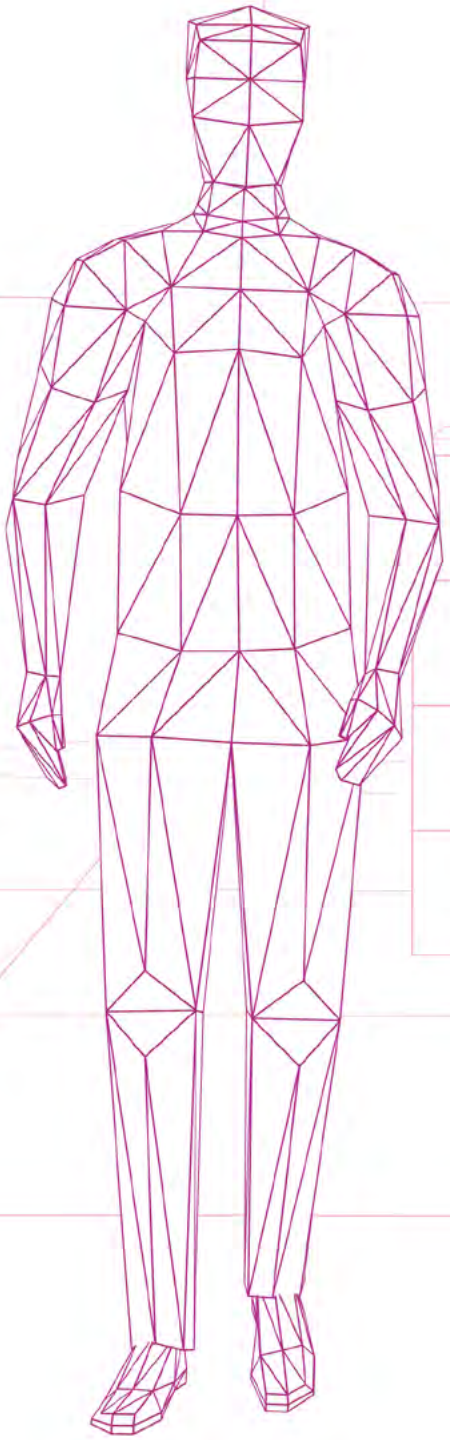
If we look at the use case of service robots, it is exciting for us to observe how people react to such robots when they meet them: Push it aside as a technical component or they interact normally and make room for them.

How do DLR, IAV and Mittweida University of Applied Sciences work together?

We have started with the common definition of various major objectives. This involved, for example, the architecture, the functional scope of the tool landscape, the decision for demonstrators and the commitment to agile methods. In detail control during project processing, we decide which sprints we plan, and which partial aspects are finally implemented.

How are the tasks distributed?

The main implementation burden lies with the Mittweida University of Applied Sciences and IAV. DLR defines the requirements for the concept and structure of the laboratory and contributes its expertise in the field of safety and security. We are very interested in high degrees of freedom in the later implementation of safety and security-oriented research questions with our partners from business and science.



What is the specific part of the IAV and Mittweida University of Applied Sciences?

IAV helps us to build the laboratory in such a way that it becomes a tool for us. In this way, we can use the infrastructure for our research questions without making the laboratory itself a fundamental subject time and time again. For us, working with an industry partner is extremely important, as we need a laboratory infrastructure at product level – with high quality standards and connectivity to practice systems.

Since we need tools to build a tool frame that can be connected to our practice partners, we develop concepts with Mittweida University of Applied Sciences that ensure close coupling.

Does it need more such cooperation?

I believe that more long-term cooperation is needed between research institutions and practice partners, because we can no longer imagine, given the complexity of IT-based solutions that is required today, that we will jump into a new topic in the short term and find a scalable problem solution there after a very short period, which is still sustainable in the long term.

We must therefore accept that many problems in the field of safety and security of AI systems can only be solved with scientifically sound approaches. We need much more intensive and long-term cooperation between economic and scientific partners in this area.

Dr. Jan Gacnik, Head of
Connectivity & Analytics at IAV

Contact
jan.gacnik@iav.de

„IAV is focusing on developing an advanced software management environment as part of the „AI in the Loop" research project. With this, new software can be continuously deployed on the robots and the execution status can be optimally monitored. Thus, complex experiments can be carried out efficiently, purposefully and quickly." Jan Gacnik

Varied software solution

IAV has acquired complete understanding of software product development according to "ASPICE Level 2" even when sophisticated variant management and automatic hardware detection are required. Recent proof: A tuner middleware for a vehicle manufacturer.

Paradigm shift in the development of infotainment systems: While OEMs used to source hardware and software mostly from tier-one suppliers, more and more manufacturers are now choosing a split. Suppliers continue to contribute the hardware, while the software is increasingly being developed by OEMs on their own responsibility – either in-house or in collaboration with partners.

"This allows manufacturers to gradually develop existing software, instead of having to purchase it completely new for each new vehicle generation," explains Torsten Herrmann, Head of Department of the subdivision HMI & Performance Software Solutions at IAV.

Distributing regular updates to vehicles is becoming much easier this way. And OEMs can deploy individual software components on a large number of control units, such as modules for in-vehicle communication. This saves costs, simplifies troubleshooting, and shortens the time to market.

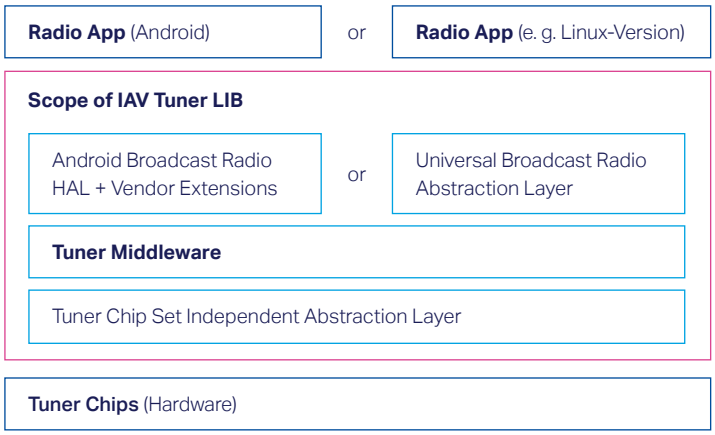
IAV can take over such projects and is currently developing a tuner middleware for an OEM. The product is based on the hardware of the radio – thus, exchanges control commands with the underlying

chips and accepts the audio signals as well as the data services of the transmitters. At the top of the software stack, the IAV software communicates with the radio app, the interface, to the driver.

Support for a wide range of radio standards

As a link between hardware and user, the tuner middleware is responsible for many tasks: Among other things, it passes on user requests to the hardware, searches the spectrum for channels in the background and decodes digital data services (for example, the display of CD covers or information about the music tracks that have just been played). The tuner middleware supports AM, FM, DAB/DAB+, HD radio and hybrid radio (uninterrupted switching between conventional and internet radio). The U.S. satellite radio Sirius could also be added later.

The tuner middleware can be adapted relatively easily to another radio hardware. Further integration into different operating systems is possible without any problems. Special adapter layers ensure this. It was also developed according to the quality standard ASPICE Level 2, thus guaranteeing complete traceability in the event of a fault – from requirements to software design and code to testing.



Software as a product
Tuner Middleware solution for the individual use

Automatic variant management

Regarding development, a particular challenge is the variant management, because the software is to be used for different brands with specific functions and each with its own design. "Our goal is to automatically generate brand-specific software," says Herrmann. "It can also be adapted to different radio standards in Europe, the U.S. and other countries without manual intervention."

To achieve this, the tuner middleware configures itself during the period of validity depending on the hardware found. The sophisticated variant management guarantees high stability and reproducibility of the software. In addition, it supports regular updates, which are played out about twice a year for the different brands.

"We fully grasp the interfaces to radio apps as well as the communication with the tuner hardware, in other words the entire software stack," says Herrmann. "This will allow us to develop such middleware from the lower to the upper layers and open up new markets."

Contact
torsten.herrmann@iav.de
detlef.raeth@iav.de

Link

Teaser

Imagine you are blind,
standing in a train station.
What do you hear?

Headline

New ways for the blind

Intro

How can blind people move around in public spaces without barriers and make full use of mobility offers? A technology solution from IAV shows how the smartphone opens up a completely new world for visually impaired people in public hotspots, also when it comes to freedom of movement.

Body text

In Germany alone, there are more than 80.000 blind people, and several hundred thousand people are visually impaired with the trend rising. However, their independence in the public space is often more or less limited by inadequate access to information such as road or information signs.

Precise environment and object recognition are of central importance for the future topic of autonomous driving, as much as the artificial intelligence (AI) required for image acquisition and processing. IAV has been developing system and software solutions for autonomous driving for years and wants to use its know-how in methods and technology to help people and the environment benefit from digital progress.

Subheading

WonderVision

Body text

With "WonderVision", IAV has developed a system that makes it easier for people with visual impairments to orient themselves via computer vision in busy indoor spaces, such as train stations, airports, hospitals or shopping centers. In the current use case, IAV focuses on railway stations, where users are guided to their destination via smartphone.

"For both the visually and the blind, mobility is a central aspect of quality of life," says Dr. Ahmed Hussein, Project Manager "WonderVision" and Concept Developer Autonomous Driving at IAV. "As a technology provider, we want to bring our expertise to other fields of application and, for example, make the environment more accessible to people with visual impairments."

Body text

The application runs as follows: The "WonderVision" technology uses image recognition as well as distance and depth estimation to record a wide variety of direction indicators, such as signs, textual notes and pictograms. From this, the system filters relevant navigation notes and makes them available to the user via voice output through an app in the smartphone.

Subheading

Development lead in the backend

Body text

IAV focuses on the evaluation of the data in the AI-supported backend, with the aim of integrating the features from object and environment detection into the existing app of a mobility or service provider.

Body text

IAV has already given proof ("Proof of Concept" – PoC) that innovative computer vision methods for integrating detection features via smartphone in the backend can be implemented. For 2023, the company is aiming for the further development of the PoC for the initial version of a product ("Minimum Viable Product" - MVP).

For almost a year, IAV has been driving the development of the backend control center of the "WonderVision" technology and has built up extensive know-how.

In addition to a running backend server with functioning sign and text recognition at stations, IAV has set up a signaling server in the cloud. This is responsible for the communication between the customer frontend and backend, and an important lever to scale the "WonderVision" technology.

Subheading

Unlimited potential for detection features

Body text

As an additional "quality barrier", IAV has established an app for error elimination with connection to the backend server to test its own algorithms before they are integrated into a customer app.

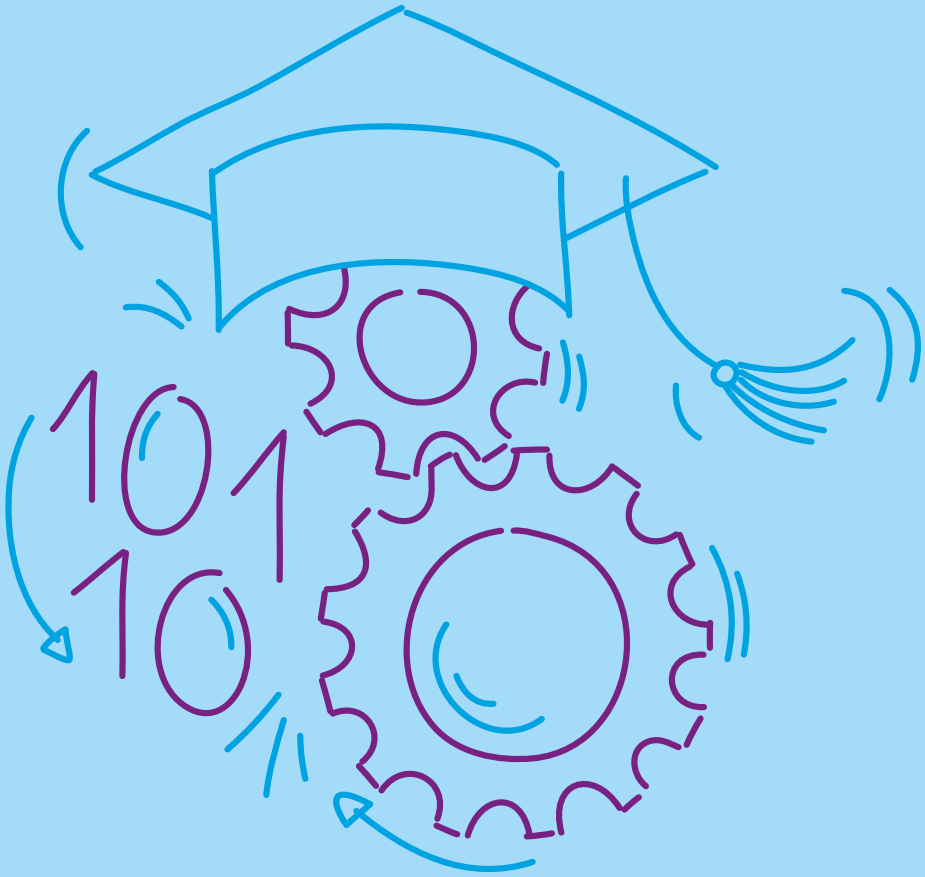
Whether it is target navigation, location determination, person recognition or simply a product search in the supermarket – the possibilities to add additional features to "WonderVision" are almost unlimited.

"By focusing on backend development, we are and remain flexible in order to be able to serve a wide range of use cases and different customers according to their needs," explains Christian März, Data Scientist in the Analytics & AI Methods team at IAV. "Railway stations are only the beginning for us."

More information about WonderVision: iav.com/en/wondervision

Contact

ahmed.hussein@iav.de
marko.gustke@iav.de



From the developer desk to the lecture hall

Carolin Schmidt (26) is an engineer at IAV and one of 13 students who have chosen the master's course "Networked Intelligent Systems" at the Mittweida University of Applied Sciences. Here she explains how she manages to balance her studies and work, and how she thinks that her professors are also her colleagues.

Carolin has always wanted to do a master's degree. After completing her bachelor's degree in mechatronics, she applies to IAV and learns during an interview that a master's degree in embedded systems is planned. She joins IAV as a systems engineer for Connected Systems & Services and decides a year later to start the master's course "Networked Intelligent Systems" at the Mittweida University of Applied Sciences.

"I chose the master because I already work in the context of networked functions and wanted to expand my position. By studying, I can get to know the entire spectrum of possibilities," says Carolin.

She likes her studies so far. This is mainly because the modules are well assembled and come into contact with new content, such as artificial intelligence. "I find the field of cryptography, where I learn how to encrypt and securely transfer one data, particularly interesting," says Carolin.

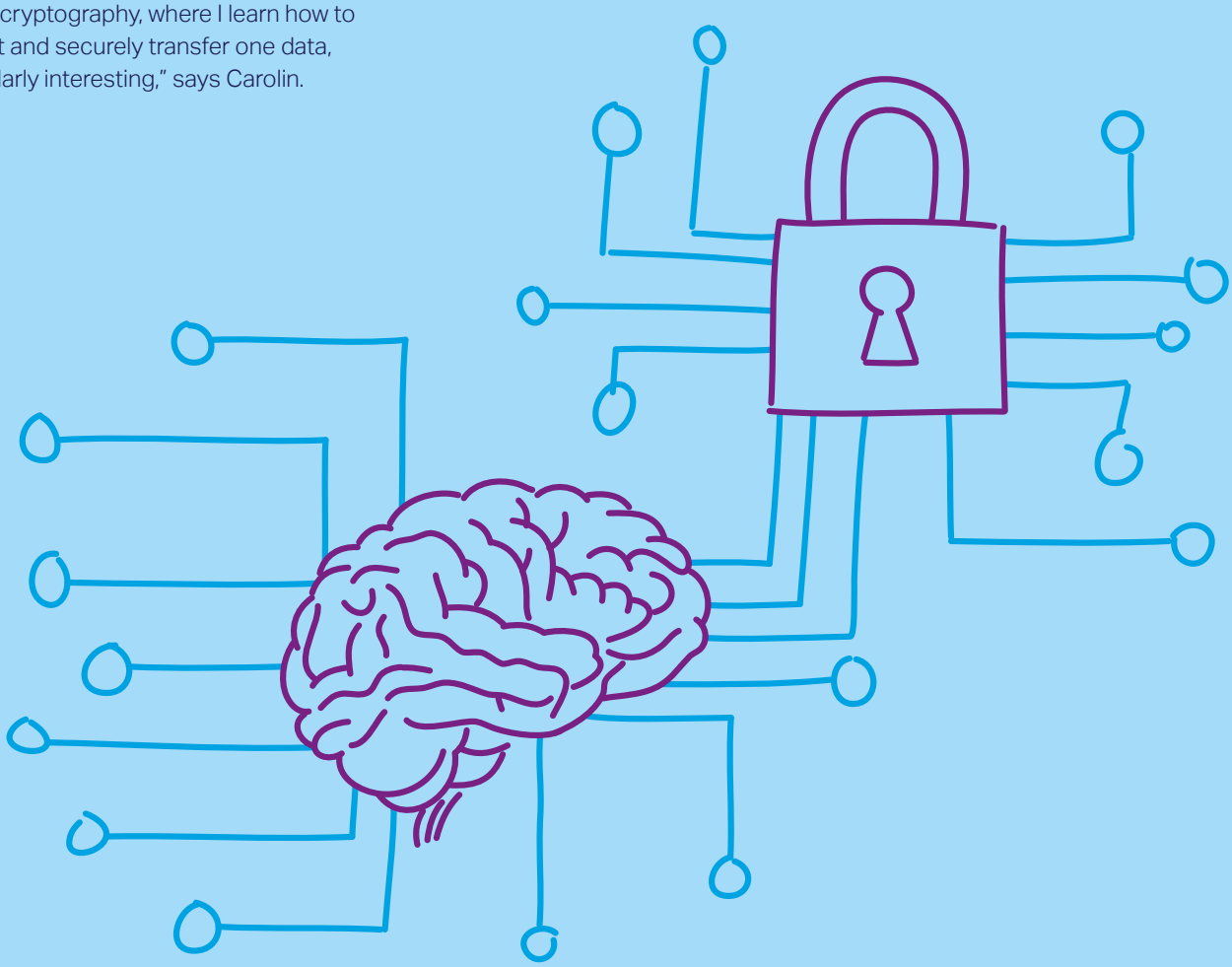
Endowed professors impart knowledge with practical relevance

She appreciates that her professors are also her colleagues. "We settle down in the lecture, but the interaction is still always collegial and at eye level." Especially in the lectures, she notices that the two endowed professors Falk Langer and Daniel Kriesten can convey their knowledge differently than the professors who have spent their entire lives in science. "One realizes that the two have a completely different basis. They use examples that they know from their own practice," says Carolin.

Students want online exams

The student knows that the master's degree is worth it. But it can also be challenging to manage studies and work. Currently, the student works for 30 hours at IAV and is completing a regular master's degree.

"What I definitely learn is stress resistance. Because it is not so easy to work and study full-time. It requires a lot of strength to structure everyday life and to cope with the tasks at work. I would like the university not only to see full-time study, but also that there are many students working in companies," says Carolin.



Her current place of residence is 350 km from the university, so it would be a great relief for her to be able to take the exams online. “From my point of view, it is part of making studying more pleasant for students who have to travel a long way.”

A worthwhile investment in the future

The master’s student sees some need for optimization, but overall, the advantages would outweigh them. “I am happy to have chosen the master’s degree and can generally say: I enjoy studying and it is worth it. Much of what is taught in the master’s degree course is reflected in my job. I am sure it will be a good prerequisite for the future and further projects at IAV.”

Promoting tech talents

The master’s program in Networked Intelligent Systems/Automotive software Engineering was designed by the Mittweida University of Applied Sciences, IAV and the Saxon Institute for Computational Intelligence and Machine Learning.

inw.hs-mittweida.de/studienangebote/elektrotechnik-automation-master/vernetzte-intelligente-systeme

Prof. Dr. Daniel Kriesten is a project manager at IAV and supervises series software projects. As a professor at HSMW, he researches complex heterogeneous systems.

“By supporting a master’s degree program at Mittweida University of Applied Sciences, IAV is blazing a trail for continuing education, transformation and recruiting skilled workers. By being integrated into the university’s operations, students not only acquire knowledge in current subject areas. In the exchange with fellow students and professors at the university, they receive cross-thematic impulses on current trends that they can implement directly.” Daniel Kriesten

Prof. Dr.-Ing. Falk Langer is endowed professor for Connectivity and Services Automotive Software at the University of Applied Sciences Mittweida and heads the Connected Systems & Services team at IAV.

“It is the right step for IAV to cooperate with Mittweida University of Applied Sciences and to be able to offer the master’s degree. We currently have a lack of specialists in almost every software area. That’s why it’s important to promote and train young talents. At the same time, IAV benefits from the fact that the Master’s graduates are trained comprehensively at the university and put their knowledge back to us after graduating. This has worked very well so far, and we already have several research assistants working for us.” Falk Langer

Contact
daniel.kriesten@iav.de
falk.langer@iav.de

IAV dates for your diary: Shall we meet?

You will find the latest updates regarding upcoming dates for your diary on our website iav.com/en/events.

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“OEMs must understand and treat their central product – the car – as a software-defined product. They must coordinate their entire world, including their infrastructure, with this.”

Jürgen Müller, Executive Vice President, Connected Software Systems & Services at IAV