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Communication Presse et Relations Publiques
Clément Lefevre
Tel.: 03 23 73 56 94
E-Mail: clement.lefevre@audi.fr

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Audi AI

Audi AI – intelligence et empathie

Connecté, autonome et électrifié – ces caractéristiques définiront l'Audi du futur. Audi AI deviendra le nom de code définissant les systèmes innovants qui soulageront la pression qui pèse sur le conducteur tout en lui permettant d'optimiser le temps passé dans son véhicule. Pour ce faire, Audi AI met en œuvre des stratégies et développe des technologies dans le domaine de l'intelligence artificielle et machine learning, se plaçant ainsi en tête de file du secteur automobile.

Les systèmes Audi AI sont capables d'apprendre et de penser, tout en étant proactifs et individuels. Avec Audi AI, les modèles de la gamme Audi sont à la fois intelligents et empathiques. Ils peuvent interagir en continu avec leur environnement et les passagers du véhicule, étant ainsi plus proches que jamais de leurs besoins.

Sur la route de la liberté
Audi AI est l'aboutissement de nombreuses années d'expériences accumulées par le constructeur en matière de concept cars et de conduite autonome. Le nouveau label se verra être un mix de systèmes électroniques et de technologies, innovants et inteligents. Audi AI créera une nouvelle forme de liberté pour le conducteur et les passagers en réduisant la complexité de l'interaction entre le véhicule et les autres usagers de la route. Divers éléments relatifs à l'intelligence artificielle joueront un rôle de premier plan dans ce système, à la fois dans le développement de nouveaux systèmes intelligents mais également pour leur utilisation ultérieure. Pour ce faire, Audi évalue diverses approches et méthodes de machine learning.

Recherches sur autoroute
Aboutissement d'une décennie de recherche, une Audi TTS autonome franchissait le grand lac salé de l'Utah (USA) dès 2009. Un an plus tard, une Audi TT autonome gravissait le Pikes Peak dans le Colorado.

En 2013, Audi a été le premier constructeur au monde à obtenir une licence d'essais dans les états de Californie et Nevada. En janvier 2015, l'Audi A7 piloted driving concept a roulé 900 km sur l'autoroute entre Stanford et Las Vegas en complète autonomie. Enfin, en mai 2015, une Audi autonome s'est frayée un chemin dans le très dense trafic urbain de Shanghai, l'une des situations de conduite les plus complexes jamais connues.

Où en est le développement de l'automobile intelligente aujourd'hui ? Des capteurs à ultrasons et radars sensitifs, des scanners laser, des systèmes basés sur caméras,

un processeur haute performance pour le traitement des données et une connexion internet rapide via le réseau de téléphonie mobile font parties des fonctionnalités présentes à bord de la nouvelle Audi A8. Les systèmes d'assistance à la conduite tels que l'active lane assist, l'adaptative cruise control (ACC) et l'assistant d'efficacité prédictif ont d'ores et déjà rendu la conduite plus sûre, confortable, et efficiente au cours de ces dernières années.

Une voiture tournée vers l'avenir
Audi AI introduit maintenant la prochaine étape : les nombreuses données de conduite recueillies par les différents systèmes d'assistance pourront bientôt être traitées beaucoup plus rapidement, et seront comparables, quasiment en temps réel, avec les données des autres usagers. Grâce Audi AI, le véhicule entièrement connecté sera bien plus ancré dans le futur qu'à l'aide des systèmes jusqu'à maintenant utilisés. En résumé, la voiture du futur aura la capacité de faire des pronostics et d'anticiper.

Dans la nouvelle Audi A8, l'Audi AI traffic jam pilot sera le premier système au monde à proposer une conduite hautement automatisée de niveau 3. Le niveau 3 signifie que dans certaines situations, le véhicule peut prendre en charge la conduite. Pendant ce temps, le conducteur n'a plus à surveiller en permanence la route, contrairement au niveau 2. Le conducteur doit simplement être en mesure de reprendre le contrôle lorsqu'il est invité à le faire. L'Audi AI traffic jam pilot est un tournant technologique important et l'aboutissement de nombreuses années de recherche et développement.

Intelligence du véhicule et possibilités d'interactions
L'intelligence des véhicules est un des éléments clés d'Audi AI. Les systèmes et technologies d'assistance intelligents ouvriront la voie vers des véhicules complètement autonomes. L'Audi AI traffic jam pilot de la nouvelle Audi A8 est le parfait exemple de l'intelligence des véhicules aujourd'hui. De nombreux capteurs scannent l'environnement puis les données sont ensuite centralisées dans l'unité de contrôle du véhicule (zFAS), qui fait pour la première fois son apparition dans l'Audi A8. Celle-ci délivre, en continu, une carte précise de l'environnement, et les données sont ensuite fusionnées une seconde fois dans l'unité de contrôle radar. La nouvelle Audi A8 est le premier véhicule de série au monde à satisfaire les exigences techniques permettant de conduire de façon autonome dans une situation de traffic.

La voiture du futur offrira beaucoup plus que l'amélioration des fonctions de conduite autonome. En parallèle de l'évolution continuelle de l'intelligence du véhicule, le niveau d'interaction s'améliorera lui aussi.

A l'avenir, grâce à Audi AI la voiture intègrera une toute nouvelle fonction : l'empathie envers ses occupants. Les systèmes intelligents transforment la voiture en un assistant pensant et capable d'empathie qui dépasse son but initial. Audi AI permettra à la voiture du futur d'anticiper les souhaits du conducteur et de ses passagers en fonction des situations, ce qui permettra de les assister de manière proactive en toutes situations. De plus, il permet de proposer un service et de le réserver de façon autonome, de la même façon qu'un concierge personnel. Audi AI créé ainsi une nouvelle forme de liberté et un nouveau type d'expérience premium.

En un mot, Audi AI présente l'interaction globale et responsable des technologies innovantes, en toute transparence, connectées avec l'infrastructure et les autres utilisateurs de la route. L'Audi du futur continuera à apprendre et à développer ses capacités. De cette façon, la technologie s'adaptera au mieux aux besoins individuels des occupants.

Audi AI change notre façon d'interagir avec les automobiles et améliore la qualité de l'expérience à bord. La voiture deviendra un « troisième espace de vie » après les foyers et lieux de travail. Les avantages individuels tirés de ce développement et la mobilité sont les principaux objectifs d'Audi. Les avantages d'Audi AI pour le client sont clairement définis : les systèmes et technologies intelligents permettent d'améliorer la gestion du temps, la sécurité, l'efficience et la personnalisation.

Avantage 1 : le temps

Des fonctions telles que l'Audi AI traffic jam pilot ou le piloted parking ne marquent que le début d'une transformation profonde et durable. Audi AI permet au conducteur du futur de vivre une expérience à bord connectée et différente de ce qui existe aujourd'hui. Lentement mais sûrement, le conducteur sera capable de lâcher le volant et d'utiliser le véhicule d'une nouvelle manière. Le véhicule autonome prenant en charge les tâches de conduite habituelles telles que le stationnement ou même le lavage, il gagnera ainsi du temps.

Gains de temps et de confort
Les systèmes d'info divertissement sont en continuel développement, grâce aux capacités croissantes d'internet permettant de partager de grandes quantités de données pendant le voyage. Simultanément, l'intégration de moyens de communication dans le véhicule continue de progresser et permet aux occupants de travailler depuis leur véhicule - par exemple en prenant part à une vidéoconférence. Le conducteur dispose ainsi de plus de temps et de nombreuses possibilités lui permettant de choisir d'utiliser son temps à bord comme il le souhaite. Mais la voiture du futur ne fera pas seulement gagner du temps et du confort sur la route

grâce aux espaces désignés « Audi AI zones », une Audi sera bientôt capable d'accomplir des tâches en totale autonomie pendant que le conducteur travaille ou profite de moment de loisir.

Audi AI Zone
Le conducteur gare son véhicule Audi dans une zone désignée (la zone de « transfert »). De là et grâce au système Audi AI, le véhicule se déplace de lui-même jusqu'à un garage équipé de nombreux services (lavage auto, point colis, station-service, prise de recharge pour véhicules électriques, etc). Connectée à son environnement, l'Audi intelligente est capable de localiser un emplacement de stationnement avant même de parcourir la zone. Au moment voulu, la voiture peut, par ailleurs, se positionner dans la zone de transfert en vue de son prochain trajet. Le conducteur peut suivre les actions du véhicule et ajouter de nouveaux services à tout moment depuis une application dédiée.

Les bénéfices de temps et confort associés aux zones Audi AI pourraient bientôt devenir une réalité. Le développement d'une interface standardisée pour la connexion des différents systèmes, ainsi que l'intégration sur le web d'applications spécifiques au véhicule seront bientôt assez matures pour une production en série. L'Audi du futur deviendra donc un élément à part entière, intégrée de manière intelligente et transparente au monde de son utilisateur.

25th HOUR
Les véhicules modernes utilisent la technologie car-to-x afin d'éviter les embouteillages. A l'avenir, la conduite autonome aidera les conducteurs pendant leurs voyages. Ainsi libéré de l'obligation de conduire, le conducteur aura les mains et l'esprit libres, se dégageant ainsi 1h par jour en moyenne.

Mais si toutes les voitures naviguent dans la ville sans que le conducteur n'ait à intervenir, comment un constructeur premium se différencie-t-il ? Dans le cadre d'un projet intitulé « 25th HOUR », Audi transformera ses clients en spécialiste de la gestion de temps. L'intérieur s'adaptera pour que le conducteur profite au maximum de son trajet pour se relaxer, profiter de sa famille, ou même travailler. En collaboration avec le Fraunhofer Institute of Industrial Engineering (IAO), Audi étudie actuellement l'influence des stimuli digitaux, lumineux ou auditifs sur l'organisme humain, concernant le stress ou la concentration par exemple. Les résultats sont destinés à inspirer les designers d'intérieur pour que la voiture devienne un lieu de travail idéal.

Avantage 2 : la sécurité

Aujourd'hui, 90% des accidents de la route sont causés par des erreurs humaines. A l'avenir, Audi AI souhaite en premier lieu empêcher les situations dangereuses pour limiter le nombre d'accident. Pour rendre la conduite autonome possible en situation de conduite difficile, il est nécessaire d'appréhender de nouvelles approches et méthodes. Des systèmes basés sur des règles précises ou des éléments relevant de l'intelligence artificielle sont à l'étude afin de développer un véhicule capable d'éviter les accidents, la priorité absolue d'Audi.

Avantage 3 : l'efficience

Des véhicules autonomes et connectés permettent d'utiliser plus efficacement l'espace et l'énergie, entrainant ainsi des bénéfices économiques et écologiques. En utilisant la technologie car-to-x (un réseau intelligent connectant les usagers de la route à l'infrastructure), le véhicule peut par exemple éviter les embouteillages et calculer un trajet optimal. Parallèlement aux bénéfices personnels des clients et aux économies d'énergie, la conduite autonome offre un autre avantage économique : les routes très fréquentées sont soumises à moins de circulation grâce à une orientation ciblée des flux de trafic.

Avantage 4 : la personnalisation

Avec Audi AI, le véhicule connait ses passagers et leurs habitudes. L'homme et la machine communiquent les uns avec les autres afin de créer une certaine confiance et faciliter les tâches routinières. Audi Fit Driver surveille l'état de santé du conducteur tandis que l'assistant personnel intelligent (PIA) reconnait le conducteur et peut interagir de manière indépendante et adaptée grâce à des algorithmes spécialisés.

Audi AI – the technology

zFAS – computing power, networking and data processing

The core of the systems which Audi is developing for piloted driving is the central driver assistance system control unit (zFAS). The mastermind makes its debut in the new Audi A8.

Until now, driver assistance systems were managed by spatially isolated control units. Audi will be the first automobile manufacturer to bundle these in a central domain architecture. To this extent, the function portfolio, the required sensors, electronic hardware and the software architecture have been combined into a single central system. Right from the outset, full attention was paid to this, and especially to the safety concept.

As a result of the vast sensor information bundled in the zFAS, it computes an entire model of the vehicle surroundings at lightning speed and provides this information to all assistance systems. It is thus also the central interface for all functions of piloted driving.

Despite compact package dimensions, it offers high computing power – the prerequisite for which are powerful electronic modular components. The zFAS – roughly as big as a tablet – is a high-tech computing center. Audi developed the zFAS with an international leading team of technology partners. It integrates high-performance chips – the Tegra K1 from NVIDIA, the Aurix from Infineon, and the Cyclon V from Altera – which are supplemented by the EyeQ3 processor from Mobileye, the world leader in image processing algorithms for the automobile industry. Its modular concept makes the zFAS flexibly scalable and thus future-proof.

Artificial intelligence and machine learning
Artificial intelligence will soon make it possible for piloted vehicles to react appropriately in highly complex situations, similar to the way in which a human driver would, or perhaps even better. As a sub-branch of information technology, artificial intelligence looks at equipping machines with similar capabilities to those of human beings. This might be achievable, for example, using machine learning.

Machine learning is therefore a pre-requisite for artificial intelligence. The basis for this comes from mathematics and statistics. In the most complex of situations, algorithms will independently find patterns and rules – and will make decisions

based on these. In the not-too-distant past, research in the field of artificial neural networks (i.e. the imitation of signal connections within the human brain) made major progress. Deep learning emulates networks of the brain on a computer. This requires enormous computing power and a broad base of data.

In intelligent and piloted vehicles, there will be numerous use cases for machine learning in the future. Thus Audi is evaluating different methods – for example supervised learning or deep reinforcement learning – with the aim of finding the optimal approach for each of these use cases. To this end, Audi is working closely with top businesses from the software field, as well as with leading universities.

Object and environment recognition
One of the most important fields of application of machine learning is currently object and environment recognition. In the Audi A4, A5, Q5 and Q7 models, object recognition has already been implemented in series production with the help of supervised learning. For this purpose, a trained system is used: the learning process is thus complete before the car goes into production.

Even in the new Audi A8, supervised learning is used for object recognition. Image processing developed by our technology partner Mobileye is based, among other things, on the deep learning method. This involves deep neural networks being trained using various data sets. In this way, the neural network learns to classify a diverse range of objects – as cars, as cyclists, as pedestrians. The data retrieved as part of this process is then made available to the final version of the driver assistance system software as well as to that of piloted driving.

Thanks to this process, the new Audi A8 therefore also detects free spaces, i.e. spaces in which it can drive. This is a major requirement for the new Audi AI traffic jam pilot.

Preliminary development projects at Audi

Audi Q2 deep learning concept:
At NIPS (Conference and Workshop on **N**eural **I**nformation **P**rocessing **S**ystems) held in Barcelona in December 2016, Audi used a scale model to demonstrate for the first time how a car can develop intelligent parking strategies. On a 3 x 3-meter *(9.8 x 9.8 ft)* field, the Audi Q2 deep learning concept autonomously searches for a suitable parking space in the form of a metal frame and then parks in it.

The model car (scale 1:8) gained the ability to park autonomously by means of deep

reinforcement learning. As part of this process, the system essentially learns through trial and error. To begin, the car selects its direction of travel at random. An algorithm identifies the successful actions, thus continually refining the parking strategy. So in the end the system is able to solve even difficult problems autonomously.

The model car's sensor technology consists of two mono cameras, one facing forward and the other towards the rear, along with ten ultrasonic sensors positioned at points all around the model. A central on-board computer converts their data into control signals for steering and the electric motor. On the driving area, the model car first determines its position relative to the parking space. As soon as this is recognized, the system calculates how it can safely drive to its destination. The model car maneuvers, steers and drives forward or in reverse, depending on the situation.

The "Audi Q2 deep learning concept" is a pre-development project of Audi Electronics Venture (AEV), an AUDI AG subsidiary.

Audi Q7 deep learning concept:
A use case for machine learning in 1:1 scale was presented by Audi in January 2017 at the Consumer Electronics Show (CES) in Las Vegas. On a specially established, adaptable open-air track, the Audi Q7 deep learning concept used a front camera with two-megapixel resolution for orientation. This then communicated with an NVIDIA Drive PX 2 computer unit which subsequently initiated the highly precise steering movement itself. The high-performance controller was specially engineered for piloted driving applications.

Serving as the core of the software are deep neural networks that experts from Audi and NVIDIA have trained specifically for autonomous driving and recognition of dynamic traffic control signals. At the beginning, the Audi Q7 deep learning concept made several laps of the track with a driver behind the wheel and additional training cameras in order to get to know the route. The system established a correlation between the driver's reactions and the occurrences detected by the cameras. As a result, the car understands external signals such as a temporary traffic light, can interpret them and deal with them as the situation requires.

The biggest difference between the Audi Q2 deep learning concept and the Audi Q7 deep learning concept is the method used for machine learning. While the 1:8 scale model car learns how to park through trial and error (deep reinforcement learning), during the training runs, the network of the Audi Q7 deep learning concept receives concrete, relevant data – in other words, it learns from a human driver (supervised

learning). Both projects are important aspects in researching the topic of artificial intelligence at Audi and illustrate the bandwidth of this approach. Audi also evaluates and trials various types of machine learning in order to implement the technologies in a targeted manner as part of new applications in the field of autonomous driving and personalization.

Car-to-x technology

See more than with the human eye or the infra-red camera – car-to-x technology expands the horizon of the established vehicle sensors based on radars, cameras and ultrasound, by supplementing these with information obtained from far away and outside of the field of vision of the driver. In this way, dangerous situations can be recognized even earlier and accidents can be avoided. Real-time communication between cars and the road infrastructure today already offers us improved safety, comfort and efficiency. With the A8, Audi will be the first manufacturer to introduce the powerful LTE Advanced mobile transmission standard.

“Traffic light information”:
The first highly-networked standard function of the car-to-x module is called “Time-to-Green”. In the Audi virtual cockpit or the head-up display, the driver sees whether the next traffic light will be green upon arrival there (within the legally permitted speed). If this is not the case, a countdown starts until the next green phase. The driver can therefore move his/her foot off the gas pedal in good time. In the future, it would also be conceivable that Audi e-tron models rolling towards a red traffic light use more of the braking energy for charging the battery. At a red light, car-to-x technology will soon make it possible for a column of vehicles to start off almost simultaneously when the light turns green. The through-flow of vehicles during each green phase should thus drastically improve.

Car drivers drive in a more forward-thinking manner thanks to this traffic light information. And that has a positive effect on traffic flow. In the future, traffic light information will, for example, also be coupled with an intelligent navigation system and will be usable in conjunction with new drive concepts. A row of green lights would thus be possible in the optimum route plan.

“On Street Parking”:
A further car-to-x service is the parking space search function, which Audi has developed under the project name “On Street Parking”. Cars equipped with car-to-x technology automatically report when they enter and leave a parking spot to the servers in the cloud. The application registers parking maneuvers based on various parameters, such as control signals of the engine, gear changes, steering angle and speed.

Using the information supplied by ultrasonic sensors or a camera, in future the system will also be able to identify vacant parking spaces while on the move. It calculates the number of free parking spaces on the side of the road based on statistical models that consider factors such as the time of day. The service shows

the driver in real time the probability of finding a free parking space, making it easier to find a spot, particularly in city centers. Unnecessary time spent searching for a parking space is thus saved and that also reduces traffic on the road.

At the same time, emissions in major cities could be effectively reduced. In today's rush hour, hundreds of cars often spend up to 30 minutes driving around residential areas looking for a parking space, but in the future, free parking spaces on the side of the road and in parking garages will be reliably shown to the driver. The driver therefore benefits from a direct journey to the location. A simple example calculation shows how much fuel and gaseous emissions could be saved by this process: an average passenger car consumes more than five liters of fuel every 100 kilometers *(1.3 US gal per 62.1 mi)* in urban traffic. This is the distance which some drivers cover in urban areas each month simply looking for a parking space. Thus, overall, each car consumes more than 50 liters *(13.2 US gal)* of fuel each year – that's an entire tank of fuel.

Voice control

The next stage of voice control can be seen in a hybrid concept. It answers questions from the driver in two ways. On the one hand, it uses knowledge about the user's preferences saved in the vehicle, while on the other hand it calls up knowledge from the cloud. What's more, the driver can formulate his/her questions or instructions freely – the self-teaching dialog manager reacts, asks questions itself where needed, or provides a list of possible selection options. In dialog with the system, the driver can switch between menu areas. For example, he/she can call a contact from the address book and have the navigation system adopt the address as the destination for route guidance. Using the destination search, the new hybrid voice control also includes media, climate control, as well as some telephone functions and some Audi connect services. In Europe, these work across borders.

Audi Fit Driver

Today already, every Audi is equipped with the latest technology and offers top-level comfort and safety. As a private place of retreat and all-round networked space, a car isn't just an ideal place for monitoring fitness levels, rather it can also actively improve the health and well-being of the driver. The Audi Fit Driver project turns the car into an empathetic assistant. In many situations, it knows what the driver needs.

The number of users of so-called wearables – fitness bands or smartwatches – continues to grow. These wrist-bound devices monitor vital parameters such as the pulse or skin temperature. In future development stages, the data of these wearables will be combinable with that of the vehicle sensors. This will then allow reliable statements to be made about the current condition of the driver, to which the car can then individually adapt. If the up-coming Audi Fit Driver detects, for example, increased stress or fatigue, the vehicle systems adapt themselves accordingly in a relaxing, a vitalizing or a protective manner. Thanks to intelligent algorithms, the system gets to know the driver better and better.

For the first time, Audi Fit Driver will allow for stress to be actively diminished and concentration increased, all whilst in the vehicle. If the system notices high stress on the driver, this can be reduced by means of a special breathing technique. The instructions for this are shown in the Audi virtual cockpit display as so-called Bio-Feedback, similar to how it works in top-level sports. Additionally, a voice over the loudspeakers guides the driver through the exercise. Whether it be relaxing breathing exercises, energizing seat massage functions to the beat of the music, special climate control functions, adaptive infotainment measures or perfectly-suited interior lighting moods: the aim of Audi Fit Driver is to create a driving experience which is optimally suited to the respective condition of the driver, which allows him/her to leave the vehicle at the destination feeling more relaxed than when he/she got in.

In a later expansion stage, Audi Fit Driver could incorporate assistance and safety systems, as well as future systems for piloted driving. In extreme situations, an Audi could initiate a piloted emergency stop and issue an emergency call using the eCall system.

Empathetic technology and gamification

The “Klara” and “Bonnie” concept studies are both based on the Audi A1 but couldn’t be more different to one another. While “Klara” features breathing bodywork and provides us with an insight into possible advances in exterior design, “Bonnie” is all about the innovative design of the interior. Both concepts share the idea of using empathetic technology or playful elements (gamification) to build up trust between man and machine – an important and basic pre-requisite for piloted driving.

Klara concept car

Being able to trust a car can best be achieved through creating empathy, whereby people near a car feel that the car is permanently keeping an eye on them and reacting in a sensitive way towards them. The “Klara – The Living One” concept study provides surprising answers to the question as to how an Audi may develop in the space of ten, twenty or thirty years: a high-tech automobile which shows emotion and which could thus become a personal friend or assistant.

At first glance, “Klara” looks like a regular Audi A1, but looks can be deceiving. Upon closer inspection, you can see that the car appears to take breaths of air in regularly spaced periods. In order for the bodywork to be able to carry out these breathing movements, 39 electric adjustment motors are at work under the metalwork. Thanks to a sensitive set of sensors, “Klara” reacts interactively and subjectively to its surroundings. If a person approaches who the vehicle perceives as friendly, it greets them by flashing its lights. But Klara is also capable of showing discontentment by growling.

For future series-production applications at Audi, particularly interesting is feedback on how “Klara” uses her empathetic reactions to establish a communication level between driver and car – and even create trust between man and machine.

Bonnie concept car

Numerous new options for personalization and interior ideas are presented by the “Bonnie” interior concept car. The driver and passengers can, for example, create drum noises by rhythmically tapping on certain surfaces in the cockpit, or they can use an app to adapt the LED ambient lighting to the color of their T-shirt or nail polish.

With the innovative lighting concept in the interior, “Bonnie” shows the possibilities that digitization in lighting design can open up and how the interior will, in future, be much more personlizable. This new type of personalization offers the advantage that drivers and passengers feel particularly good. Anyone can change the interior lighting color at any time to suit their favorite color. If a person uses multiple vehicles, for example as in car sharing, the person’s favorite color can be carried with them from vehicle to vehicle. Thus, each vehicle feels like his/her own car. The same applies if several people – for example a family – share one vehicle.

Besides personlizable LED ambient lighting, “Bonnie” offers other ideas for illumination: surface lights instead of the familiar ceiling-mounted grab handles, air vents and loudspeakers illuminated from the inside, a particularly bright light for the footwell and luggage compartment, as well as a carpet of light for the immediate vehicle surrounding.

The sports seats make use of sustainable materials which feel like real suede. The start button is integrated into the shift lever knob and the shift point display in the flat-bottomed steering wheel. A smartphone and a tablet stowage tray highlight the target customers of this concept study: young professionals and young-at-heart over-50s who always have their mobile devices with them. A handbag holder in front of the front-passenger seat prevents handbags from slipping forward in the footwell upon braking. For heavily-used training shoes, there is a sort of dirt bucket under the double floor of the luggage compartment. The lid embedded in the luggage compartment floor extends the stowage height, for example for transporting potted plants or larger bunches of flowers.

A thrilling entertainment feature of “Bonnie” is the “Drumbase” function. Piezo sensors in the steering wheel, the air vents and in the lid of the glove compartment precisely register drumming by the driver and passengers, while a computer turns them into drum noises.

It almost sounds as if a real drum kit is on-board the Audi A1. This playful approach ensures a new type of possibility to while away the time on-board. Similar gamification gadgets may, in future, also be interesting in piloted vehicles.

Personal intelligent assistant (PIA)

The best operating concept is the one which is ideally adapted to the driver, the one which relieves him/her of as many actions as possible and which autonomously carries out routine operational inputs – PIA, the personal intelligent assistant, follows precisely this principle. Using artificial intelligence methods, PIA combines data intelligently with one another – data from the car, data about the driver, about the current or up-coming traffic situation, as well as data from the internet. Among other things, PIA responds to voice inputs and, thanks to intelligent algorithms, it can interact with the user independently and adaptively.

PIA looks at the activities of the driver and, based on them, gets to know his/her typical behavior. This opens it up to use for a broad range of possible applications: navigation, selection of music, selection of the desired Audi connect service, climate control, suggestion of a parking space or maintaining the regular distance to vehicles traveling in front on the motorway. Based on the knowledge ascertained through machine learning, PIA adapts the car's functions to the behavior and needs of the driver and can actively make recommendations.

A server in the secure Audi cloud hosts and processes the PIA data. Customers can view and manage these data at any time via their myAudi account. These can then be deleted or modified, for example in the event of moving house. What's more, they can be automatically transferred to other cars. The car identifies the individual user, loads the right user profile, and PIA then adapts the car and its interactive behavior accordingly.

Audi Electronics Venture GmbH (AEV), an Audi subsidiary, has overall responsibility for the PIA predevelopment project. Initial elements could make their way into production before the end of this decade and then gradually expand to create a perfect, tactful driver's assistant.

Data protection/privacy

Audi treats data protection as a high priority. Audi fully complies with the respective national laws governing personal data, data protection and privacy rights. The brand follows clear principles in handling the personal data of customers.

– Fin –

dans 12 pays. AUDI AG possède plusieurs filiales à 100 %, dont les sociétés Audi Sport GmbH (Neckarsulm/Allemagne), Automobili Lamborghini S.p.A. (Sant'Agata Bolognese/Italie) et Ducati Motor Holding S.p.A. (Bologne/Italie).

En 2016, le groupe Audi a livré à ses clients environ 1,868 million d'automobiles de la marque Audi ainsi que 3 457 voitures de sport de la marque Lamborghini et environ 55 451 motos de la marque Ducati. En France, en 2016, Audi réalise une année record avec 64 671 immatriculations. AUDI AG a réalisé au cours de l'exercice 2016 un résultat d'exploitation de 3,1 milliards d'euros pour un chiffre d'affaires de 59,3 milliards d'euros. L'entreprise emploie actuellement quelque 88 000 personnes dans le monde entier, dont plus de 60 000 en Allemagne. Audi se concentre sur des produits et des technologies durables pour l'avenir de la mobilité.