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Press release

January 6, 2020
PI 11071 RB ts/BT

CES 2020: Bosch raises the bar when it comes to artificial intelligence

Beneficial AI: building trust in the technology together

- Bosch board of management member Michael Bolle: “Bosch aims to become an innovation leader in the field of AI as well.”
- Technology of the future: Bosch invests 3.7 billion euros annually in software development.
- Training program: over the next two years, Bosch will make 20,000 associates ready for AI.
- Interaction: thanks to AI and the IoT, Bosch makes everyday life easier in mobility, at home, and in manufacturing.
- A world first: digital sun visor uses AI to protect drivers’ vision the smart way.

Las Vegas, NV, USA – Whether for automated driving, the smart home, or manufacturing: artificial intelligence (AI) has become an integral part of everyday life. Bosch uses AI and the internet of things (IoT) to make life easier for people and as safe as possible. Here, the slogan “Beneficial AI. Building trust together” sums up the technology and services company’s approach. The focus is on safe and robust AI for the manufacture of smart products, which Bosch will be showcasing at this year’s CES. One of these products is the Virtual Visor: an AI-based digital vehicle sun visor that will be making its debut at the world’s largest trade fair for consumer electronics. The product has also won a CES® Innovation Award, as has Bosch’s 3D display for the car.

Other Bosch AI highlights at the show include an application for predictive maintenance of the International Space Station, a system for monitoring vehicle interiors, and a smart platform for medical diagnostics. “The solutions we’re showcasing at CES make it clear that Bosch aims to become an innovation leader in AI as well,” says Bosch management board member Michael Bolle. “As of 2025, every Bosch product will either contain artificial intelligence or will have been developed or manufactured with the help of AI.” The global market volume for AI applications is expected to be around 120 billion dollars over that same

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period, a twelvefold increase compared to 2018 (source: Tractica). Bosch wants to tap into that potential: the company already invests 3.7 billion euros each year in software development, currently employs more than 30,000 software engineers, and has 1,000 associates working on AI.

In addition, Bosch has established a comprehensive training program. “We plan to make nearly 20,000 associates AI-savvy over the next two years,” Bolle explains. “We must invest not only in artificial intelligence, but in human intelligence as well.” The program includes training formats at three different levels for managers, engineers, and AI developers and includes guidelines for using AI responsibly. To that end, Bosch has drawn up its own set of AI principles that address issues of AI security and ethics. With this in combination with its expertise, the company intends to build trust with customers and partners alike: “Anyone who has internalized technical and ethical principles knows how important data security and sovereignty are,” Bolle says. “In a way, trust is the product quality of the digital world.”

Expertise saves lives

In the future, Bosch believes one core area of expertise will be the industrial application of artificial intelligence. “We want to harness the power of artificial intelligence not for the purpose of creating models of human behavior, but instead to improve technology to benefit people,” Bolle says. “For this reason, industrial AI has to be safe, robust, and explainable.” According to Bosch, that means people should always remain in control, whether on the street, at home, or in manufacturing.

As a pioneer in the development of life-saving driver safety systems such as ABS, ESP, and airbag control units, the company has already proved in the past that people benefit from reliable machines. AI can also make driver assistance systems even more efficient and intelligent: when Bosch’s AI camera for automated driving identifies partially concealed pedestrians, for example, the automatic emergency braking assistant can react even more reliably. Bosch is creating learning technology that is “Invented for life.”

Bosch invests 100 million euros in an AI campus

Innovations require investment. In addition to spending on software development, Bosch is investing worldwide in people and in competence centers. For example, the company is investing 100 million euros in the construction of a new AI campus in Tübingen, Germany. The move into the new research complex is planned for the end of 2022. It will then offer some 700 AI experts space for creative and productive exchange. These experts come from Bosch, external startups, and public research institutions. The new campus should strengthen

exchange among experts in Cyber Valley. “Building trust together” will be a living reality there. Bosch is a founding member of Cyber Valley, which was established in 2016. This joint research venture brings together partners from industry, academia, and government to drive forward AI research and quickly transfer research findings into real-world industrial applications.

In addition, the Bosch Center for Artificial Intelligence (BCAI) operates at seven locations worldwide, including two in the U.S.: in Sunnyvale, California and Pittsburgh, Pennsylvania. The BCAI currently has a total of some 250 AI specialists working on more than 150 projects in the domains of mobility, manufacturing, smart homes, and agriculture.

World-first Virtual Visor originated in the U.S.

Bosch has creative AI minds developing product innovations for mobility, the smart home, and Industry 4.0. Its AI world first for the automotive sector, which is celebrating its world premiere in Las Vegas, originated in the U.S.: the Virtual Visor, which is a transparent digital sun visor. A transparent LCD display connected to the interior monitoring camera detects the position of the driver’s eyes. Using intelligent algorithms, the Virtual Visor analyzes this information and darkens only the portion of the windshield through which the sun would dazzle the driver. The Virtual Visor scored the highest in its category at the CES Best of Innovation Awards. Bosch’s new 3D display won its category as well. Using passive 3D technology, the display generates a realistic three-dimensional effect for images and alerts. This allows visual information to be grasped faster than when displayed on conventional screens, increasing road safety.

Additional safety comes from Bosch’s new interior monitoring system for vehicles. It detects when the driver is drowsy or looks at a smartphone based on eyelid movements, direction of gaze, and head position – and alerts the driver to critical situations. It also monitors the vehicle interior to determine how many occupants are present and where and in what position they are sitting. This makes it possible to optimize the operation of safety systems such as the airbags in an emergency.

In 2019, Bosch sales of driver assistance systems rose by 12 percent to around 2 billion euros. They are paving the way for automated driving. In the future, when vehicles are in partially automated driving mode for sections of the journey such as on the freeway, the driver monitoring system will become an indispensable partner: In these situations, the camera will ensure that the driver can safely take the wheel again at any time. By 2022, the company will have spent around 4 billion euros on automated driving and will employ more than 5,000 engineers. To round out its sensor portfolio in this domain, Bosch is now

working on making lidar sensors production-ready as well. In addition to radar and cameras, lidar is the third essential sensor technology. The Bosch long-range lidar sensor can also detect non-metallic objects at a great distance, such as rocks on the road.

Bosch AI used in space and in medicine

The company is aiming high with its SoundSee sensor system, which was sent into space at the end of 2019. Riding on NASA's autonomous flying Astrobee robot, SoundSee will isolate unusual sounds on the ISS, analyze the audio using AI-driven analytics, and indicate when maintenance is necessary. Starting in early 2020, audio data captured by Soundsee will be delivered to a ground control facility configured to meet NASA specifications and built into the Bosch Research Center in Pittsburgh, PA. The system, which is barely bigger than a lunchbox, was developed in the U.S. together with Astrobotic as part of a NASA research collaboration.

A completely earthbound but no less innovative product is Vivascope, a smart pathology platform that helps in medical diagnosis. Vivascope magnifies specimens like blood and other bodily fluids, digitizing the microscopic findings, and analyzing them with the help of artificial intelligence-powered algorithms. It is capable of precisely and rapidly identifying cell anomalies and providing physicians with useful support in evaluation and diagnosis.

Smartglasses Light Drive make everyday glasses smart

Bosch is also showcasing many non-AI innovations at CES. For example, its Light Drive smartglasses module is the world's first sensor-based solution for making a normal pair of glasses smart. It is more than one-third thinner than other solutions on the market and weighs less than ten grams. The crystal-clear images projected into the wearer's field of vision, which are clearly discernible even in direct sunlight, range from navigation information and text messages to calendar entries and operating instructions – depending on the information received from a smartphone or smartwatch.

At CES, Bosch is using its IoT shuttle technology showpiece to present the solutions that the company offers automakers and mobility service providers for the electrification, automation, connectivity, and personalization of ridesharing vehicles. Its portfolio goes beyond components to include seamlessly connected mobility services that give users flexibility in how they operate, manage, charge, and maintain their fleet vehicles, as well as making each journey safe. At the Bosch booth, visitors can also see improved drive and sensor technologies for the connected and emissions-free mobility of the future.

Solutions for the entire house: expanded portfolio for residential IoT
Bosch is expanding the scope of its services for the residential internet of things (IoT). The highlight here is the open Home Connect platform, which is being showcased at CES. Starting in mid-2020, the platform's app will also offer control of lighting and shade, entertainment, and smart gardening equipment from different manufacturers. The number of partner companies, which is currently at 40, is set to more than double, making life at home even more convenient and efficient.

Smart technology protects the environment
Underlying all these innovative products is Bosch's entrepreneurial mindset. "We want to harmonize commercial, environmental, and social responsibility," Bolle says. Climate protection is also a major concern here. According to Bolle, "Bosch not only develops environmentally friendly solutions, but also acts as a role model. By the end of 2020, all our 400 locations worldwide will be climate neutral and from development to manufacturing to administration no longer leave a carbon footprint. We've already achieved this for our German locations."

Artificial intelligence plays a role here, too: at individual locations, for example, an in-house energy platform uses intelligent algorithms to identify deviations in energy consumption. This alone has enabled some plants to reduce their CO_2 emissions by more than 10 percent over the past two years. Considering that Bosch operates a total of 270 such plants, the savings potential is enormous. As Bolle explains, "That's how we sum up our message at CES: Bosch has big plans for AI in many respects."

Press photos: #2716453, #2898173, #2898611, #2901305, #2913526, 2913527

Bosch at CES 2020:

- **PRESS CONFERENCE:** In Ballrooms B, C, and D, Mandalay Bay Hotel, Las Vegas **South Convention Center, Level 2**, from **9:00 to 10:30 a.m. local time on Monday, January 6, 2020.**
- **BOOTH: Tuesday to Friday, January 7–10, 2020**, in the Central Hall, booth #12401
- **FOLLOW** the Bosch CES 2020 highlights on Twitter: **#BoschCES**
- **PANELS WITH BOSCH EXPERTS:**
  Wednesday, January 8, 2020, 10:15 to 11:15 a.m. (local time)
  Event entitled "Growth of Apprenticeships for 'New Collar' Jobs" with Charlie Ackerman, Senior Vice President of Human Resources, Las Vegas, South Convention Center

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The Bosch Group is a leading global supplier of technology and services. It employs roughly 410,000 associates worldwide (as of December 31, 2018). The company generated sales of 78.5 billion euros in 2018. Its operations are divided into four business sectors: Mobility Solutions, Industrial Technology, Consumer Goods, and Energy and Building Technology. As a leading IoT company, Bosch offers innovative solutions for smart homes, smart cities, connected mobility, and connected manufacturing. It uses its expertise in sensor technology, software, and services, as well as its own IoT cloud, to offer its customers connected, cross-domain solutions from a single source. The Bosch Group's strategic objective is to deliver innovations for a connected life. Bosch improves quality of life worldwide with products and services that are innovative and spark enthusiasm. In short, Bosch creates technology that is "Invented for life." The Bosch Group comprises Robert Bosch GmbH and its roughly 460 subsidiary and regional companies in over 60 countries. Including sales and service partners, Bosch's global manufacturing, engineering, and sales network covers nearly every country in the world. The basis for the company's future growth is its innovative strength. At nearly 130 locations across the globe, Bosch employs some 68,700 associates in research and development.

The company was set up in Stuttgart in 1886 by Robert Bosch (1861–1942) as "Workshop for Precision Mechanics and Electrical Engineering." The special ownership structure of Robert Bosch GmbH guarantees the entrepreneurial freedom of the Bosch Group, making it possible for the company to plan over the long term and to undertake significant upfront investments in the safeguarding of its future. Ninety-two percent of the share capital of Robert Bosch GmbH is held by Robert Bosch Stiftung GmbH, a charitable foundation. The majority of voting rights are held by Robert Bosch Industrietreuhand KG, an industrial trust. The entrepreneurial ownership functions are carried out by the trust. The remaining shares are held by the Bosch family and by Robert Bosch GmbH.

Additional information is available online atwww.bosch.com, www.iot.bosch.com, www.bosch-press.com, www.twitter.com/BoschPresse.

January 6, 2020
RF 11082-e

Beneficial AI – building trust together in the digital world

Dr. Michael Bolle,

member of the board of management

of Robert Bosch GmbH,

and Mike Mansuetti,

president of Bosch in North America,

at the Consumer Electronics Show

in Las Vegas on January 6, 2020

Check against delivery.

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2001: A Space Odyssey.
The Terminator.
The Matrix.
Ex Machina.
It sounds like we're sharing a list of our favorite movies. But actually, all these movies have something in common.

They all depict a future in which machines have learned to think for themselves – with disastrous consequences for humanity. Whether the machines manipulate, enslave, or replace us, the message in the movies is the same: by developing artificial intelligence, we're opening Pandora's box.

I like science fiction as much as anyone, and portraying AI as the villain has kept audiences entertained for decades. But the time has come to talk about the technology's true potential – the potential to provide real value, for real people. "How can we make artificial intelligence beneficial? How can it be used to complement human intelligence?" These are some of the big questions at CES this year. So what's our answer?

Artificial intelligence is not science fiction anymore – it's already an integral part of our daily lives. It's fundamentally changing how we drive, how we work, how we learn, how we shop, how we travel. At Bosch, it's also becoming part of the products we make – products that will assist and support us, and make life easier overall. Whether it's being used in manufacturing, in smart homes, or in self-driving cars, one thing is for sure – in line with our "Invented for life" ethos, we want to make AI safe, robust, and explainable.

Where the world of work is concerned, we're not just facing a technological shift, we're also facing a critical shortage of skilled workers. So it's also against this backdrop that it will be essential for

humans and machines to work together. At Bosch, we believe this is self-evident. And with this in mind, we're trying to shape the digital transformation by educating and upskilling our workforce, and investing in our associates as well as in the intelligence of our products and machines.

As a society, we must learn to accept a technology that is capable of learning itself. One way to do this is to invest more in our own learning – and that's exactly what we're doing.

Over the next two years, we will be introducing wide-ranging training programs aimed at making nearly 20,000 of our associates AI-savvy. I'll tell you more about that later.

But the societal benefits of AI go far beyond our daily lives and work. It also holds tremendous potential to benefit our planet and its climate. We intend to use this potential to realize our goal to maintain a balance between our economic, ecological, and social responsibilities.

At the end of 2019, we achieved carbon neutrality for all our locations in Germany. By the end of this year, all 400 Bosch locations worldwide will be completely carbon neutral. When this happens, we will be the first major industrial enterprise to have achieved this ambitious goal, all within a little over a year.

And to do this, we will be making use of our own solutions as well: our energy platform, for example, already uses intelligent algorithms to monitor consumption in manufacturing. It quickly identifies deviations in individual machines' energy use and offsets load peaks. This alone has reduced CO_2 emissions at individual plants by more than ten percent over the last two years. For a company that has 270 manufacturing sites, that's some significant savings potential! Our success here has prompted us to market the energy platform

externally. And it won't end there: AI means we'll be able to forecast and reduce energy consumption over the long term as well.

AI is creating markets, but digital trust is indispensable

This example underlines that artificial intelligence also offers considerable business potential. A number of different studies support this notion. For example, AI is expected to boost GDP substantially in major economies across the globe by the end of this decade – PWC estimates a 15 percent boost in North America alone. At the same time, global AI software revenue is projected to reach nearly 120 billion dollars by 2025, a twelve-fold increase compared to 2018. And the World Economic Forum predicts that global job losses as a result of AI will actually be offset by the creation of new ones, resulting in a net gain of nearly 60 million new jobs by 2022. As mentioned earlier, these jobs will require significantly new competency profiles, which will necessitate a strong push to reskill and upskill people.

It's indisputable that the impact of artificial intelligence will be huge. However, we must make the benefits of AI comprehensible for people, and even more importantly, establish trust in the digital world. Our CES slogan captures our approach here nicely: "Beneficial AI – building trust together." In this endeavor, Bosch is pursuing a two-pronged approach.

On the one hand, we're doing the technical groundwork, developing solutions, and using our innovations to open up new areas of business. On the other hand, we will use AI to realize our strategic imperative of creating technology that is "Invented for life," and in doing so, convince society of the benefits of AI.

Remember, it was our engineers that developed lifesaving inventions such as electronic stability control, airbag control units, and anti-lock

braking systems for vehicles ranging from passenger cars to motorcycles to e-bikes. This is what we mean by technology “Invented for life” – and our work with AI is no exception. By putting it to use in automated vehicles, for example, it too will be a technology that saves lives, as we will explain in more detail later on.

Trust, responsibility, and ethics in AI

We take entrepreneurial responsibility seriously, and it defines our approach to new technologies like artificial intelligence.

The decisive factor for responsibility in the digital world is trust. This trust will be just as important for our digital business as product quality is for our traditional business. We have to work on developing both AI and trust in AI – without the latter, the former will not be successful in the long run. But how can we establish this trust? By creating AI that is transparent, safe, secure, and robust.

When it comes to building trust, another key aspect is data security and data privacy – especially where personal data is concerned. At Bosch, our approach is simple: when it comes to all our smart products and services, users have full transparency and control over the data collected and who gets to use it.

Moreover, in order to build trust among our customers and partners, as early as 2015 we established guiding principles for data protection in our IoT business. This was several years before the GDPR regulatory framework was introduced as European standard. We’re now working on a similar set of principles for our future use of artificial intelligence: an AI code which sets out ethical guidelines for the development and usage of AI, especially in cases of doubt and dilemma.

Going forward, it will be essential that people remain in control of systems that use AI. Take the example of driver assistance: here, we want to integrate AI in such a way that it can always be overridden by the driver. We don't want to lock the algorithms from our AI models in a little black box. The rules and parameters behind decisions must remain comprehensible, at the very least for specialists.
That said, Bosch and the big tech players differ in our approaches to AI in one fundamentally important way: our focus is on the application of AI for physical objects. Whether it's deployed in an automotive emergency braking system or in factory production, our AI explains the physical world to machines. Our latest camera for automated driving uses AI to understand what it sees – to infer, say, whether a pedestrian is going to step out into the road or not. This will improve object recognition and make automatic emergency braking more reliable, thereby increasing safety.

At Bosch, we want to harness the power of artificial intelligence to improve technology and the performance of our products and machines. We call this industrial AI, and we're using it to develop smart solutions in three key domains: mobility, residential, and manufacturing.

It's no coincidence that we emphasize the "things" when talking about IoT. We're bringing connectivity and intelligence to our own products and machines. We know cars and traffic, factories and buildings, inside and out – no other tech company can match the breadth and depth of our cross-domain expertise.

Our own sensors provide us with a massive amount of data. And if we apply AI methods to that data, we can create new services and applications. By the middle of this decade at the latest, each and every one of our products will either have artificial intelligence itself, or have been developed or manufactured with its help. Ultimately, we plan to

teach our products to function as assistants – for our customers, and for our own developers.

Investing in AI research and development

To achieve this, we want to become one of the global leaders in AI innovation as well. Our research and development activities are all geared toward this goal. Bosch currently invests more than 4 billion dollars annually in software development, and employs around 30,000 software engineers. Established in 2017, the Bosch Center for Artificial Intelligence is already working on more than 150 projects. It employs some 250 AI specialists at seven locations around the globe including two here in the U.S. – in Pittsburgh, Pennsylvania, and Sunnyvale, California. Our U.S. research teams play a key role in our AI development activities, above all in robotics and automated driving.

But we're not working in a vacuum here. Especially where AI is concerned, a technology company like Bosch sees itself as part of the larger scientific community. In Germany, for example, we're a founding member of the "Cyber Valley" initiative – an AI research alliance between academia and industry. Among other things, as part of this we're investing more than 110 million dollars in an AI campus, which from late 2022 will be home to 700 AI experts from Bosch as well as from external startups and research groups.

Here in the U.S., we're collaborating closely with Carnegie Mellon University on AI research. Carnegie Mellon has been working on artificial intelligence for 60 years, since the technology's earliest days. They have been responsible for pioneering innovations in areas like self-driving cars, facial recognition, and language processing.

As we see it, industry and academia each have an essential contribution to make. And we highly value the transfer of knowledge between our developers on both sides of the Atlantic.

SoundSee hears what's broken in space – with AI from Bosch

A great example of an exciting collaboration with one of our U.S. partners is currently deployed about 240 miles above the Earth's surface.

It's an innovative AI-based sensor system called SoundSee. This little device will be playing quite a big role in outer space. The SoundSee technology will be used to perform deep audio analytics on the ISS. Using highly-sensitive microphones, it will capture ambient noise emitted from the station's systems and equipment, and then use AI to spot potential anomalies from the audio patterns. Basically, SoundSee will hear if something on the station is broken – and can tell whether it needs to be repaired or replaced.

We developed this system together with the aerospace company Astrobotic Technology Inc. In November, it was sent into orbit and will be integrated into the Astrobee robot shortly. Of course, the new sensor system will also be very useful down here on earth. In manufacturing, for example, it can improve predictions about machine downtimes, thus helping to reduce maintenance costs and increase productivity. But on board the ISS, this technology could even be lifesaving.

Virtual visor – a U.S. idea is a "Best of Innovation" award winner

We're showcasing another example of the ingenuity of our American workforce here at CES – and this world premiere also underlines their lateral thinking. Some of our engineers came up with a digital solution

for a common and often dangerous hazard that drivers frequently face. It's an innovation that replaces a nearly 100-year-old automotive product: the sun visor.

According to a study by NHTSA, sun glare causes nearly twice as many accidents as any other type of weather-related condition. But we now have a solution: our "virtual visor." At first glance, it looks like a see-through LCD display mounted at eye level. The special thing about it, though, is that it's connected with a driver-facing camera equipped with AI facial detection and analysis. Its software calculates both the driver's line of sight and the angle of the sun in order to strategically darken individual sections of the display. Everything else remains transparent.

We think the Virtual Visor is another great example of technology "Invented for life," and the CTA apparently thought so too. The product was honored with a prestigious CES 2020 Best of Innovation Award – you can test it out for yourself at our booth.

3D vehicle display – our second Best of Innovation Award

Our new 3D vehicle display also won a CES Best of Innovation Award – and I've been told it's no small feat to win two of those.

Vehicle displays in general offer huge business potential – after all, the global market volume is set to more than double by 2025, to 30 billion dollars. Our award-winning display uses a multi-view 3D technology which is especially affordable, since it works without the need for eye tracking and 3D glasses.

To describe how it works, let's go back to the movies for a moment. We've all seen 3D films, where the technology makes our experience more vivid and entertaining. Inside a vehicle, 3D performs a similar but

more useful function: it helps people understand information more quickly. The display's depth of field means drivers can grasp important visual information faster, whether it's an alert from an assistance system or a hazard warning. Alerts seem to jump out of the display and are much more obvious and urgent, as well as far harder to overlook. I don't know about you, Michael, but anything that tells me what I really need to be paying attention to is a win in my book.

Interior monitoring – technology that can help keep children safe

Think of the dangers posed by fatigue and distraction – the longer we're behind the wheel and the more technology is present in the cockpit, the greater they are. Here, our driver monitoring system uses artificial intelligence to identify these distractions through cameras which recognize the driver's line of sight, head position, and blink rate. When it determines a critical point has been reached, it reacts by sounding an alarm or providing driving assistance, depending on the automaker's wishes, and also legal requirements. In the EU, this kind of system is set to be standard in new vehicles from 2022. This technology will also play an important role in automated driving. After all, the next few development stages will still require drivers to remain alert and ready to take over in critical or tricky situations. To ensure drivers are able to do this, the monitoring system calculates how ready they are to respond at any given time, and the transfer of driving responsibility is then timed accordingly.

Depending on the design, some systems can also monitor the car's other occupants and enhance their safety, for example by detecting changes in passengers' sitting positions and adjusting their airbags and seatbelt tensioners for optimal crash protection. Or by identifying the presence of children inside parked cars. In 2018, parked cars claimed the lives of more than 50 children in the United States, either because they had been left inside for longer than intended or had

climbed in unnoticed. Bosch's new system can recognize the presence of children and warn parents in a flash by sending a message to their smartphone. In a critical situation, it can also alert the emergency services. As the Hot Cars Act currently being debated in Congress shows, there is considerable interest in solutions to prevent these tragedies. Once again, our technology doesn't just make life better, it can help to save lives. Looking ahead, we plan to extend our interior monitoring systems to encompass in-vehicle sensing and deploy this in ridesharing fleets. In-vehicle sensing will allow us to detect when a passenger leaves something behind in a shared car, for example, or if they need help in a critical situation.

For us, offering real benefits is what it's all about. Nearly all our driver assistance systems enhance both safety and convenience. We are one of the automotive industry's leading suppliers in this field. In 2019, our sales rose by 12 percent to some 2.3 billion dollars. From a technical point of view, we're using driver assistance as a stepping stone to automated driving. By 2022, we will have invested some 4.7 billion dollars in developing this technology and increased our workforce of dedicated engineers to 5,000. To this end, we're working on making lidar sensors production-ready. Alongside our new video camera with AI and radar and ultrasonic sensors, Bosch will soon offer the complete sensor portfolio needed for automated driving. Few automotive suppliers worldwide have as much expertise in this area as Bosch.

Our lidar will be the first of its kind that is suitable for use in automotive applications, since it's scalable and can be manufactured in large volumes. It's also the first lidar technology to be suitable for automated driving functions at SAE levels 3-5, offering long-range sensing capabilities in combination with a wide field of view and an exceptionally high resolution. Working together, our multiple sensor types will help to ensure extremely reliable environment recognition. To

surmount the many challenges on the road to fully-automated driving, Bosch is bringing together its profound expertise in sensors and systems and that's the type of expertise that only an automotive company can have.

We're already testing automated driving in a range of environments, including one that is widely regarded as the final frontier: city streets. I'm happy to report that our pilot project with Mercedes-Benz for an on-demand ride-hailing service with automated vehicles is now up and running. Automated S-Class vehicles are now providing an app-based shuttle service in California between West San José and downtown for selected users. Ultimately, the aim of this project is to gain valuable insights for the development of automated driving, and to answer the question of how self-driving cars can best be integrated into a multimodal mobility system. Our development work on this project encompasses both the use of AI as well as simulations and tests designed to address the kind of driving situations that occur very rarely in road traffic.

We're not just using our mobility solutions to teach cars how to drive. We're also using them to make electric and connected driving a reality. This is enabling us to open up new areas of business and forge partnerships with new customers. For example, we're developing a hydrogen powertrain for the heavy-duty trucks made by U.S. startup Nikola Motor Company. We're also suppling our solutions to mobility service providers such as DiDi and Lyft. For DiDi, we'll soon be providing a cloud service that helps to extend the service life of car batteries. When it comes to urban mobility for the future, you can experience our vision in an IoT concept shuttle at our booth. This year we're showcasing what we offer mobility service providers to help them operate safe and efficient automated ridesharing and ride-hailing businesses.

Bosch MEMS technology – for smart glasses without the sci-fi look

Beyond this, we're also using our expertise in everything related to mobility as the basis for innovation in other domains. The best example of this is sensors based on micromechanical systems – called MEMS for short. We're the market leader for these sensors, which are used for automotive applications as well as smartphones. Our latest development in this area is being showcased here at CES: our light drive system for smart glasses. The smallest of its kind, it's nearly a third slimmer than existing ones on the market and can be integrated into nearly any type of frame, becoming part of your everyday glasses. It uses a MEMS-based laser scanner and holographic mirror to project an image on the wearer's retina. This image can contain any kind of text message – for example from the navigation system or your personal calendar. And you, in turn, can be kept constantly up to date – without looking like you're on the way to a Star Trek convention every time you put them on.

Another domain where AI has the potential to deliver enormous benefits is healthcare. Here, our Indian engineers have developed a cutting-edge innovation called Vivascope, which is a CES® innovation award honoree. In a nutshell, it's a smart pathology platform for medical diagnostics powered with advanced machine learning algorithms. With the help of AI, it analyzes human cells' form, shape, and structure for deviations, thus providing physicians with information on possible diseases. And it does so in minutes, which dramatically shortens the testing process. Helping people diagnose health issues quicker and more accurately – this is also what we mean by technology "Invented for life."

AIoT to benefit everyone – training for tomorrow's work

As we see it, the IoT and AI should benefit everyone. To do this, they must be more than technological gimmicks and actually make people's daily life and work easier. This is true for all our domains: connected mobility, connected homes, and also connected industry. Especially in the world of manufacturing, artificial intelligence can supplement human creativity, and more crucially, relieve workers of routine tasks.

On every new path we tread, we take our workforce with us. On our way to creating the factories of the future, we want to prepare our associates for the work they'll be doing in the future. This brings us full circle to our AI training program, which I mentioned earlier. It consists of three parts:

First, we're training roughly 16,000 executives on the business aspects of AI. Our digital transformation is enabling us to master a balancing act: on the one hand, remaining an industrial enterprise, and on the other, becoming a leading IoT and AI provider. For this, our leadership will have to be capable of making the right decisions, which is why we're building up their AI expertise.

Second, we're expanding our AI learning platform. This platform is similar to an online university, but uses examples and exercises from real-life operations at Bosch. More than 1,500 of our engineers are already using the platform, a number that will likely double by next year. Some of its notable features are the exchange of experience our AI learning platform facilitates, as well as the use of best-practice examples and competitions.

Third, we're training nearly 500 experienced engineers in AI development methodology. This is the highest level of our training

program, what is effectively a supplemental course of study in things like data engineering and data analysis. We're not just increasing the number of AI engineers by hiring dedicated specialists; we're also doing it by reskilling our existing people.

All told, this will get 20,000 of our associates up to speed on the technology. As we see it, it's not only part of our corporate responsibility to offer this kind of training, it's also in our strategic interest.

Conclusion

Ladies and gentlemen, it's clear that developing artificial intelligence will require us to focus on more than just technological innovation. On one hand, we need to invest heavily in human intelligence, and on the other, we need to convince people of the true potential of this technology. "Beneficial AI: building trust together" – it's more than just a nice catchphrase we're using here at CES. We truly believe that AI holds the key to making our lives safer, easier, and more eco-friendly. Please come visit our booth in the Central Hall to see some examples of this in action. And together, let's work to dispel any doubts and usher in a new era of real-life science fiction, where AI is the hero.

Press release
Bosch Compact

CES 2020: Bosch presents intelligent technology that is "Invented for life"

Bosch booth: Central Hall, #12401 / Twitter #BoschCES

January 6, 2020
PI 11066 RB ts/af

- Award-winning: Bosch receives the Best of Innovation award – twice – for its world-first virtual visor and the 3D vehicle display.
- Out of this world: Bosch AI system analyzes instruments on board the ISS.
- Suitable for everyday use: Bosch technology revolutionizes the design of data glasses.

Stuttgart, Germany / Las Vegas, NV, USA – **At CES® 2020** in Las Vegas, **Central Hall, booth #12401 from January 7 to 10, 2020,** Bosch is presenting connected products for mobility and the home. Among the highlights at the trade fair are solutions that either make use of artificial intelligence (AI) or that were developed or manufactured with its help. The international supplier of technology and services wants to make AI safe, robust, and explainable, whether in manufacturing, smart homes, or automated driving.

CES 2020 Innovation Awards: award-winning Bosch solutions

In the run-up to CES 2020, Bosch twice received the highest score in the Innovation Awards and was also a three-time Honoree. The CES Innovation Awards are an annual program run by the Consumer Technology Association (CTA) covering 28 categories, and serve as an indicator of future trends. In addition to the 3D display for cars, a world first from the Car Multimedia division also received the coveted Best of Innovation award: the virtual visor. Both innovations were also designated Honorees in other categories. The third Honoree distinction goes to Bosch Vivascope – a smart platform for medical diagnostics.

A world first: virtual visor – the transparent digital sun visor (AI inside):

Conventional sun visors shield car drivers from dazzling light. But folding them down often also blocks significant areas of the driver's field of vision. Bosch has solved this problem with a new, transparent LCD display that replaces opaque

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visors. The virtual visor is connected to the interior monitoring camera, which detects the position of the driver's eyes. Using intelligent algorithms, the virtual visor analyzes this information and darkens only the portion of the windshield through which the sun or other light sources would dazzle the driver. The rest remains transparent, leaving the driver's view of the road unobstructed.

3D display – bringing the third dimension to the cockpit: The new Bosch 3D display uses passive 3D technology to generate a realistic three-dimensional effect for images and warning signals. This allows visual information to be grasped faster than when displayed on conventional screens, reducing driver distraction. Furthermore, this display system with spatial depth works completely without additional features such as eye tracking or 3D glasses.

Vivascope – a smart pathology platform for medical diagnostics (AI inside): Bosch Vivascope can magnify microscopic samples of blood and other bodily fluids, take a digital picture of them, and analyze them using artificial intelligence powered algorithms. The device has already been trained on more than 30,000 images and some nine million discrete points cells using machine learning methods – and it is still learning. It is able to determine irregularities in cells quickly and precisely, supporting doctors during evaluation and diagnosis.

A Bosch must-see

SoundSee – intelligent ears for the ISS (AI inside): Barely bigger than a lunch box, Bosch's SoundSee is packed with state-of-the-art artificial intelligence (AI). SoundSee is already in orbit and will soon be deployed onboard on the International Space Station (ISS.) Riding on NASA's flying autonomous Astrobee robot, the SoundSee uses integrated microphones to capture ambient noise in space and then analyze the audio using AI-driven analytics. By using artificial intelligence, SoundSee can analyze audio data to spot potential anomalies and give an indication of when maintenance work is needed. In early 2020, audio data captured by SoundSee will be delivered to a NASA-spec'd ground control facility built into the Bosch Research Center in Pittsburgh, PA. SoundSee was developed together with Astrobotic as part of a NASA research collaboration.

Light Drive smart glasses – keeping information always in view: Bosch Sensortec is presenting Light Drive smart glasses – the world's first solution for making a normal pair of glasses smart. The integrated projection system consists of MEMS mirrors, optical elements, sensors, and an intelligent software connection. Light Drive smart glasses are more than one-third thinner than previous solutions on the market and weigh less than ten grams. The crystal-clear images they project into the wearer's field of vision, which are clearly discernible even in direct

sunlight, range from navigation information and text messages to calendar entries and operating instructions – depending on the information they receive from a smartphone or smartwatch.

Interior monitoring – safety, comfort, and convenience for all occupants (AI inside): Based on eyelid movements, direction of gaze, and sitting position, this Bosch vehicle interior monitoring system detects when the driver is drowsy or looks at a smartphone – and alerts the driver to critical situations. It also monitors the vehicle interior to determine how many occupants are present and where they are seated. This makes it possible to optimize the operation of safety systems such as the airbags in an emergency. What's more, the system increases occupants' comfort and convenience. For instance, it automatically activates stored personal settings such as seat position. In the future, when vehicles are in partially automated driving mode for sections of the journey such as on the freeway, the driver monitoring system will become an indispensable partner: the camera will ensure that the driver can safely take the wheel again at any time.

Bosch IoT Shuttle – the future of mobility: In the future, mobility service providers (MSPs) will increasingly use shuttles to offer customized on-demand mobility – whether for road freight or passenger transport. At CES, Bosch is using its IoT Shuttle technology showpiece to present the solutions that the company offers automakers and MSPs for the electrification, automation, connectivity, and personalization of shuttles. Its offering goes beyond components to include seamlessly connected mobility services that give users flexibility in how they operate, manage, recharge, and maintain their fleet vehicles, as well as making each journey safe.

Mobility of the future: selection of solutions and services

Lidar sensors – the third type of sensor technology needed for automated driving, alongside radar and camera: Bosch is extending its sensor portfolio for automated driving and is making long-range lidar sensors production-ready. Bosch long-range lidar will be the first solution available on the market suitable for automotive use. This means that it can be manufactured in large volumes and will work reliably throughout a car's service life. Lidar plays a key role in ensuring that highly-automated vehicles can reliably detect hazards even in challenging driving situations – situations where radar and cameras come up short. The long-range lidar can also detect non-metallic objects at a great distance, such as rocks on the road.

Intelligent front camera – understanding images with computer vision and AI (AI inside): This camera detects objects, categorizes them into classes such as vehicles, pedestrians, or bicycles, and measures their movement. The camera is also capable of interpreting what it sees to distinguish between the lane and the grass shoulder or roadside structures – even in the absence of road markings. In congested urban traffic, the camera can also recognize and classify partially obscured or crossing vehicles, pedestrians, and cyclists quickly and reliably. This allows the vehicle to trigger a warning or emergency braking.

Radar sensors – surround sensors for complex driving situations: The latest generation of Bosch radar sensors are even better at capturing the vehicle's surroundings – including in bad weather or poor light conditions. Their greater detection range, wide aperture, and high angular resolution mean automatic emergency braking systems can react more reliably.

Automated valet parking – fully automated valet parking service: This joint development by Bosch and Daimler is the first SAE Level 4 system to be officially approved for everyday use in Germany. The sensors for the parking garage infrastructure and the communications technology come from Bosch. By the end of 2021, it is expected that a dozen other parking garages will be equipped with automated valet parking. Bosch is working on this together with parking garage operators and developers of major real-estate projects.

Vehicle computer – next-generation electronics architecture: One key to the future of connected, automated, and electrified mobility is vehicles' electronics architecture. Not only will new, high-performance vehicle control units make vehicles considerably more powerful in the future, but by reducing the number of ECUs, they will also reduce vehicle weight and complexity in the interactions between components and systems. Bosch vehicle computers will increase computing power by a factor of 1,000 by the start of the next decade. The company is already creating these kinds of computers for automated driving, the powertrain, and the integration of infotainment systems and driver assistance functions.

Perfectly keyless – the smartphone as car key: In the future, Perfectly keyless will use not only Bluetooth for communication between the vehicle and a smartphone, but also ultra-wideband (UWB), a new communications technology that is already available in some smartphones. UWB lets smartphones be localized to within a few centimeters. It also makes communication with the vehicle particularly secure. Bosch is currently working with partners to standardize data transmission between smartphones and vehicles. At CES,

Bosch is presenting a demonstration vehicle in which Perfectly keyless makes use of UWB for the first time.

Fuel-cell system – electromobility for the long haul: Mobile fuel cells offer long ranges, short refueling times, and – with hydrogen produced using renewable energy – emissions-free operation of electric vehicles. Bosch is currently commercializing a fuel-cell stack together with the Swedish company Powercell. In addition to the stack, which converts hydrogen into electrical energy, Bosch is developing all the essential system components to a production-ready stage.

Rolling chassis – electromobility platform: Electrical powertrains, steering systems, brakes – Bosch has all the building blocks of electromobility in its portfolio. As part of a development partnership with the chassis and automotive technology expert Benteler, the company is demonstrating how all Bosch products for electric vehicles can be integrated with one another. The rolling chassis showpiece is, among other things, helping Bosch to strategically refine products to meet such requirements.

E-axle – SiC technology for high-performance electric vehicles: Bosch is presenting its new Performance e-axle, which incorporates new technological solutions to further increase the efficiency and power density of electrical powertrains. The new drive unit features improved system efficiency of up to 96 percent, which extends vehicle range by up to six percent in the WLTP test cycle. And at tree kilowatts of power per kilogram, the power density is 50 percent higher than in the previous e-axle. These improvements are due to the pioneering use of silicon carbide (SiC) semiconductors in the power electronics as well as a space-saving arrangement of the electric motor, power electronics, and transmission.

Connected biking – solutions that deliver a cycling experience 2.0: The Kiox on-board computer keeps training data such as speed, pulse, and the rider's own performance in view throughout the ride. Once the ride is over, users can evaluate the data in the eBike Connect smartphone app or in the online portal. Kiox also boasts a new premium function called Lock, which provides digital protection against theft. Meanwhile, the new SmartphoneHub lets e-bikers enjoy all-around connectivity when riding thanks to the COBI.Bike app, which offers a wide range of functions – from navigation and fitness tracking to connections with third-party services and apps such as Apple Health, Google Fit, and komoot.

Intelligent assistants: safety and comfort on the road and at home

Home Connect – an expanded platform for everyone: Bosch is broadening the scope of its services for the residential internet of things (IoT). Home Connect, the company's open IoT platform encompassing household appliances from Bosch and other manufacturers, is being extended from the kitchen and laundry room to the rest of the home. Starting in mid-2020, Home Connect will offer control of a wide range of additional connected solutions, including lighting, heating, security, and entertainment devices from different manufacturers. Some 40 partner companies currently use the platform, and this number is set to more than double with its expansion, making home life for users even more comfortable, convenient, and efficient.

Bosch Smart Home – new degrees of openness: Bosch Smart Home is soon to be compatible with Apple HomeKit. In the future, it will be possible to control the Bosch smart-home system using the Apple Home app and the Siri voice assistant. To enhance customer benefits even more, in the future Bosch will offer its partners the option of including Bosch smart-home devices and services in their own offerings via an application programming interface (API).

Application Store – everything under one roof: IoT connectivity has a key role to play, especially when it comes to security technology. Now the Bosch subsidiary Security and Safety Things has developed its own IT platform in an effort to make coordinating devices, software, and data for video and security applications in commercial buildings as effective as possible. Thanks to this platform, it takes no time at all to test the compatibility of an app with its intended application or to implement systems. Sample applications in the area of connected living and mobility will be on display at CES.

Spexor – a feeling of safety anytime, anywhere: This compact mobile alarm device can be placed wherever safety is paramount. Whether at home, in the car, in the motorhome, or in the shed – Spexor will keep reliable watch and immediately report any break-ins. The device is fitted with noise, motion, and air-pressure sensors, as well as GPS. If the device detects an intruder, it sends a warning to the user's smartphone via Wi-Fi or the low power wide area (LPWA) IoT wireless technology standard.

Press photos: #1849025, #2898169, #2898170, #2898171, #2898173, #2898174, #2898521, #2901307

Bosch at CES 2020:

- **PRESS CONFERENCE:** In Ballrooms B, C, and D, Mandalay Bay Hotel, Las Vegas **South Convention Center, Level 2**, from **9:00 to 10:30 a.m. local time on Monday, January 6, 2020.**
- **BOOTH: Tuesday to Friday, January 7–10, 2020**, in the Central Hall, booth #12401
- **FOLLOW** the Bosch CES 2020 highlights on Twitter: **#BoschCES**
- **PANELS WITH BOSCH EXPERTS:**
  Wednesday, January 8, 2020, 10:15 to 11:15 a.m. (local time)
  Event entitled "Growth of Apprenticeships for 'New Collar' Jobs" with Charlie Ackerman, Senior Vice President of Human Resources, Las Vegas, South Convention Center

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The Bosch Group is a leading global supplier of technology and services. It employs roughly 410,000 associates worldwide (as of December 31, 2018). The company generated sales of 78.5 billion euros in 2018. Its operations are divided into four business sectors: Mobility Solutions, Industrial Technology, Consumer Goods, and Energy and Building Technology. As a leading IoT company, Bosch offers innovative solutions for smart homes, smart cities, connected mobility, and connected manufacturing. It uses its expertise in sensor technology, software, and services, as well as its own IoT cloud, to offer its customers connected, cross-domain solutions from a single source. The Bosch Group's strategic objective is to deliver innovations for a connected life. Bosch improves quality of life worldwide with products and services that are innovative and spark enthusiasm. In short, Bosch creates technology that is "Invented for life." The Bosch Group comprises Robert Bosch GmbH and its roughly 460 subsidiary and regional companies in over 60 countries. Including sales and service partners, Bosch's global manufacturing, engineering, and sales network covers nearly every country in the world. The basis for the company's future growth is its innovative strength. At nearly 130 locations across the globe, Bosch employs some 68,700 associates in research and development.

The company was set up in Stuttgart in 1886 by Robert Bosch (1861-1942) as "Workshop for Precision Mechanics and Electrical Engineering." The special ownership structure of Robert Bosch GmbH guarantees the entrepreneurial freedom of the Bosch Group, making it possible for the company to plan over the long term and to undertake significant upfront investments in the safeguarding of its future. Ninety-two percent of the share capital of Robert Bosch GmbH is held by Robert Bosch Stiftung GmbH, a charitable foundation. The majority of voting rights are held by Robert Bosch Industrietreuhand KG, an industrial trust. The entrepreneurial ownership functions are carried out by the trust. The remaining shares are held by the Bosch family and by Robert Bosch GmbH.

Additional information is available online at www.bosch.com, www.iot.bosch.com, www.bosch-press.com, www.twitter.com/BoschPress.

Press release
Bosch Healthcare Solutions

January 5, 2020
PI 11065 RB TB/cs

Dr. AI – Bosch facilitates medical diagnosis with artificial intelligence
Vivascope cell-analysis platform named CES 2020 Innovation Award Honoree

- Intelligent: Edge-computing machine-learning algorithms detect abnormalities in bio samples and thus support faster diagnosis and treatment
- Connected: Exchange of digital data enables remote analysis, peer consulting, and expert review
- Intuitive: Easy operation and integrated battery allows use in remote and resource-constrained locations

Bengaluru, India. 1 in 1.5 million – a ratio that can have dire consequences. In some regions of the world, there is just one pathologist – only one clinical expert capable of analyzing bio samples for diseases and disorders – for every 1.5 million people. As a result, people either have no access to laboratory diagnostics, or they have to make an expensive and time-consuming journey before they can consult a pathologist. The few practicing pathologists that are available tend to work under time pressure, leading to delays and human error. To make medical diagnostics more accessible, Bosch has developed Vivascope – a compact device that not only creates digital microscopic images of body cells, but also analyzes them using advanced machine-learning algorithms. Vivascope has been recognized as a CES® Innovation Award Honoree in the "Tech for a Better World" category.

"Artificial intelligence and connectivity offer enormous opportunities, also in the healthcare sector. We at Bosch are working on connected solutions and artificial intelligence that serve people and improve their quality of life," says Marc Meier, president of Bosch Healthcare Solutions GmbH. "True to our 'Invented for life' ethos, Vivascope helps detect potential diseases and disorders more quickly and easily."

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Analysis within 15 minutes, over 30 distinct conditions

Especially in remote areas and in facilities that do not have access to high-end equipment, patients may have to wait anywhere from three to eight days to receive any findings following the collection of samples. Vivascope is designed to remedy this situation. Currently, almost two-thirds of clinical diagnosis is done manually, by means of a conventional optical microscope. The accuracy of the diagnosis also depends on the pathologist's expertise and experience. A combination of a large number of samples and labor-intensive methods impacts not only the time taken but also the accuracy of the findings.

Vivascope can analyze human cell morphology in a short time. Its inbuilt AI algorithm analyzes cells' form, shape, and structure. It categorizes them and detects minute deviations. Vivascope was developed with the support of clinical physicians and laboratory experts in India. It is expected to be launched there in mid-2020. Further regions are to follow. Up to now, the platform has been trained with more than 30,000 images and in excess of 9 million discrete points of cells, and is capable of extracting 165 distinct features from each individual cell. It is able to carry out an automated evaluation within 15 minutes and to provide the pathologist with information on more than 30 possible diseases or clinical disorders. In addition to evidence-based reporting, each analysis is validated by a pathologist to ensure precise diagnosis.

Vivascope achieves the same results with the thousandth sample as with the first, since the algorithm does not grow tired and is not susceptible to human weaknesses. "Incorporating innovative features enabled by cutting-edge technologies, the product is well placed to make a significant difference to people and to the world of pathology," says Sri Krishnan V., the senior vice president responsible for innovation and incubation at Robert Bosch Engineering and Business Solutions Pvt Ltd in India. The information provided by Vivascope relieves medical laboratory personnel of the time-consuming and tedious burden of manual analysis steps. It allows them to focus on more complex cases and on diagnosis, so that accurate results are achieved faster. Especially in regions where there are very few pathologists, but not only there, this is a huge benefit.

Easy access to the lab – from anywhere

While Vivascope can support pathologists all over the world in the remote evaluation of different samples, for people living in vast hinterland regions it offers a possibility of access to laboratory diagnostics. "If the patient cannot come to the laboratory, the laboratory comes to the patient," says Guruprasad S., vice president at Robert Bosch Engineering and Business Solutions in India and business domain leader for its healthcare activities. The product requires only a simple power-on, and can be seamlessly integrated into hospital and laboratory

information systems. The inbuilt battery pack ensures more than six hours of continuous operation, even in black-out conditions. The data stored in the cloud can be shared digitally with other laboratories – anytime, anywhere in the world.

As it is an open and digitally connected platform, the device enables further academic processing by the research community and peer-to-peer collaboration. In addition to the CES "Tech for a Better World" Honoree, the platform has also received the European Product Design Award 2019 in the Industrial and Life Science Design/Medical/Scientific Machinery category.

Press photo: #2901305, #2901307, #2912516

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About Bosch Healthcare Solutions

Bosch Healthcare Solutions GmbH is a wholly owned subsidiary of Robert Bosch GmbH. The subsidiary was established in 2015 with the aim of developing products and services that improve people's health and quality of life. About 120 associates (state 2019) are currently employed at the company's headquarters in Waiblingen, Germany. The subsidiary's solutions draw on the Bosch Group's core competencies: sensors to collect data, software to evaluate that data, and services based on this data analysis.

About Robert Bosch Engineering and Business Solutions Private Limited

Robert Bosch Engineering and Business Solutions Private Limited is a 100% owned subsidiary of Robert Bosch GmbH, one of the world's leading global supplier of technology and services, offering end-to-end Engineering, IT and Business Solutions. With over 20,000 associates, it's the largest software development center of Bosch, outside Germany, indicating that it's the Technology Powerhouse of Bosch in India with a global footprint and presence in US, Europe and the Asia Pacific region.

About Bosch

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Press release

January 5, 2019
PI 11070 BBM Fi/af

Safe eyes save lives: How Bosch engineers are innovating the 95-year-old sun visor

Bosch's new Virtual Visor greatly improves driver safety and comfort

- Sun glare causes thousands of automotive accidents a year, almost two times more than any other weather-related condition.
- Virtual Visor features a single, transparent LCD panel, a driver-facing camera with AI facial detection and analysis and tracking software.
- Dr. Steffen Berns: "Some of the simplest innovations make the greatest impact, and Virtual Visor changes the way drivers see the road."
- Bosch at CES®: Virtual Visor named Best of Innovation in CES 2020 Innovation Awards; see it in action at booth #12041 in Central Hall.

Farmington Hills, Michigan – Bosch is rethinking driver safety and comfort, bringing one of the most overlooked interior components into the spotlight, the sun visor. The sun causes twice as many car accidents as any other weather-related condition due to temporary blindness. The National Highway Traffic Safety Administration reports thousands sun glare-related car accidents each year, and another study indicates the risk of a car crash is 16 percent higher during bright sunlight than normal weather. The traditional sun visor is not equipped to adequately address this safety concern. At best, it blocks some of the sun from your eyes but along with it, some of your view is blocked as well.

Bosch is offering a solution with the revolutionary Virtual Visor, a transparent LCD and intuitive camera, which replaces the traditional vehicle sun visor completely. As the first reimagined visor in nearly a century, Bosch's technology utilizes intelligent algorithms to intuitively block the sun's glare and not the view of the road ahead.

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“For most drivers around the world, the visor component as we know it is not enough to avoid hazardous sun glare – especially at dawn and dusk when the sun can greatly decrease drivers’ vision,” said Dr. Steffen Berns, president of Bosch Car Multimedia. “Some of the simplest innovations make the greatest impact, and Virtual Visor changes the way drivers see the road.”

The Virtual Visor, which was honored as a Best of Innovation in the CES 2020 Innovation Awards, will debut at CES 2020 in Las Vegas. The Virtual Visor was also named as an honoree in the awards competition, which recognizes products across 28 categories. Virtual Visor received the Best of Innovation for the In-Vehicle Entertainment & Safety category, as it received the highest ratings from a panel of judges that includes designers, engineers and members of the tech media.

A sun visor fit for the future

Virtual Visor links an LCD panel with a driver or occupant-monitoring camera to track the sun’s casted shadow on the driver’s face. The system uses artificial intelligence to locate the driver within the image from the driver-facing camera. It also utilizes AI to determine the landmarks on the face – including where the eyes, nose and mouth are located – so that it can identify shadows on the face. The algorithm analyzes the driver’s view, darkening only the section of the display through which light hits the driver’s eyes. The rest of the display remains transparent, no longer obscuring a large section of the driver’s field of vision.

“We discovered early in the development that users adjust their traditional sun visors to always cast a shadow on their own eyes,” said Jason Zink, technical expert for Bosch in North America and one of the co-creators of the Virtual Visor. “This realization was profound in helping simplify the product concept and fuel the design of the technology.”

The creative use of liquid crystal technology to block a specific light source decreases dangerous sun glare, driver discomfort and accident risk; it also increases driver visibility, comfort and safety.

Innovation from the recycling bin

From the original ideation and concept phase to testing and prototyping, Virtual Visor is a bottom-up solution made possible through the innovation culture established at Bosch. Employees are encouraged to apply lean startup methodologies to confirm customer benefits, market potential and feasibility for new ideas, which are then validated by peers and approved for development.

“We’ve built a culture around empowering our associates by putting them in the driver’s seat,” said Mike Mansuetti, president of Bosch in North America. The Virtual Visor was developed by a team in North America as part of Bosch internal innovation activities. “As a leading global technology provider, we understand that innovation can come from any level of an organization, and we want to see that grow.”

A group of three powertrain engineers, led by Zink, developed the idea for Virtual Visor and created prototypes in their free time in order to secure internal funding for the project concept.

“Like many early-stage ideas, we were working with limited capital and resources,” said Zink. “The original prototype, we used to first pitch the concept, was made from an old LCD monitor we recovered from a recycling bin.”

The Virtual Visor team received mentorship from Bosch executives as they sought funding and developed additional versions of the product. Ultimately the product was transitioned into the Bosch Car Multimedia division.

Press photos: #2898611, #2898612, #2932109, #2932110, #2932111, #2932112, #2932113, #2932114

Further information:
Video about the Virtual Visor ##2932115

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Bosch at CES 2020:

- **PRESS CONFERENCE:** From **9:00 to 10:30 a.m.** local time **on Monday, January 6, 2020** in Ballrooms B, C, and D, Mandalay Bay Hotel, Las Vegas **South Convention Center, Level 2**
- **BOOTH: Tuesday to Friday, January 7–10, 2020**, in the Central Hall, booth #12401
- **FOLLOW** the Bosch CES 2020 highlights on Twitter: **#BoschCES**

- **PANELS WITH BOSCH EXPERTS:**
  Wednesday, January 8, 2020, 10:15 to 11:15 a.m. (local time)
  Growth of Apprenticeships for “New Collar” Jobs session with Charlie Ackerman, Senior Vice President of Human Resources, Las Vegas South Convention Center

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Press Release
Bosch Smart Home

New Year, New Perspectives – Bosch Smart Home at the CES in Las Vegas

6th of January 2020
PI 11067 HOME CT

The highlights at a glance:

Bosch Smart Home becomes even more open

- Compatible with Apple HomeKit
- Partner interface for integration into partner apps

The Bosch Smart Home alarm system becomes even safer

- Integrated control of roller shutters for unobstructed escape routes in case of fire
- Activation of all connected light switches in case of burglary

Intelligent heating becomes even smarter

- New room thermostat for optimal room temperature
- Integration of electric radiators

Stuttgart/Las Vegas. Bosch Smart Home is synonymous with smart innovations and intelligently connected devices that make homes safer and optimize living environments. At the CES in Las Vegas, the company is therefore presenting new products, features and interesting new partners that enable users to enjoy even greater security, living comfort and freedom in 2020.

More freedom, more potential – Bosch opens its Smart Home System

Loyal Apple fans in particular have yet another reason to look forward to the New Year because the Apple Home-App will soon be able to control the Bosch Smart Home System. In combination with an iPhone, iPad, Apple TV or smart HomePod loudspeaker, this offers numerous operating options, including interaction with other Apple HomeKit-capable devices. After the voice services from Amazon Alexa and Google Assistant have already been integrated, during the course of 2020 the Bosch Smart Home System will also be conveniently controllable via Siri, Apple's voice assistant.

Starting this year, Bosch Smart Home will also offer an open interface for selected partners. This will enable the partners to integrate Bosch Smart Home devices into their own solutions via a cloud API.

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Thanks to this integration, the partner apps will be able to display the status of Bosch Smart Home devices and services, e.g. the alarm system. Furthermore, the partner apps will also be able to control the devices. For users, this capability opens up a wide range of potential applications outside the Bosch Smart Home for a safer life and an optimized living environment. The first partner apps will be able to control Bosch Smart Home cameras as early as the spring of 2020.

Bosch Smart Home is taking the first visible step together with Home Connect as its partner. Home Connect combines various areas such as security, lighting, sun-protection and entertainment on a cross-brand platform. The interplay between Home Connect and Bosch Smart Home will be demonstrated in a live show at Bosch's stand at the CES.

The Bosch Smart Home alarm system becomes even more secure

The Bosch Smart Home alarm system offers reliable protection against burglary and fire. In the event of an alarm, it notifies residents directly onsite via audible signals and also provides remote notification by sending a live image to the user's smartphone. The alarm system also offers greater security within the user's own four walls by integrating the control of roller shutters and lighting. In the event of a fire, all networked roller shutters are automatically opened to quickly assure that escape and rescue routes are clear and unobstructed. As an additional alarm function in the Bosch Smart Home System, the lighting control system provides even better deterrence against uninvited guests in the event of a burglary. The Bosch Smart Home System triggers red Philips Hue lamps to begin flashing and automatically lights up all lamps that are integrated via flush-mounted light switches.

Intelligent heating becomes even smarter

Bosch Smart Home enhances the efficiency and convenience of heating with various networked products such as radiator thermostats, door/window contacts with ventilation detection, room thermostats for underfloor heating and individualized time programmes. New: at CES, Bosch Smart Home presents the room thermostat for optimizing room temperature. Thanks to its wireless power supply and radio connection, the room thermostat can be conveniently installed anywhere in the room. In conjunction with the smart radiator thermostats, the desired room temperature is thus achieved and maintained precisely where it is needed.

In addition, the room thermostat will soon also be able to control electric radiators connected via adapter plugs. You can find further information here.

Visit Bosch Smart Home in Central Hall, Stand #12401 from Tuesday through Friday, 7 to 10 January 2020.

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Robert Bosch Smart Home GmbH was founded as a wholly-owned subsidiary of Robert Bosch GmbH. Based in Stuttgart-Vaihingen, the company offers intelligent solutions for retail customers who desire a networked home from a single source. Bosch Smart Home simplifies home living by unobtrusively controlling routine activities in the background. It offers solutions for a safer life and an optimal living environment.

More information is available at www.bosch-smarthome.com

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Press Release
Bosch Smart Home

The Bosch Smart Home Room Thermostat
Even simpler and more efficient temperature optimization

6th of January 2020
PI 11068 HOME CT

- **Utmost efficiency:** precise measurement and regulation of room temperature
- **Maximum freedom:** can be installed anywhere thanks to wireless power supply
- **More possibilities:** controls radiator thermostats and electric radiators

Stuttgart/Las Vegas – Bosch Smart Home is expanding its product family with an additional intelligent product that makes heating and home living even simpler and more convenient. The new room thermostat rapidly regulates and precisely measures the ambient temperature in the room. The room thermostat connects with the radiator thermostats to further increase the efficiency and convenience of heating control.

Accurate and individualized heating

Whether the space is a living room, bedroom, hobby room or kitchen, every room in the house needs individualized heating, custom-tailored for its uses and its specific conditions, to achieve the perfect indoor climate for optimal wellbeing.

With the Bosch Smart Home room thermostat, temperature and relative humidity are no longer measured directly on the radiator, but precisely at whichever point in the room is most important for its occupants. This significantly increases the efficiency of the heating control system and conserves resources, especially if the room is large or the radiators are concealed.

Thanks to its battery-powered wireless power supply and its wireless connection to the Bosch Smart Home System, the room thermostat can be easily installed anywhere in the room. This ensures that the desired room temperature is achieved precisely where it is needed.

The new room thermostat will soon also be able to control electric radiators. This will be made possible by a smart adapter plug that integrates the radiators into the

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room climate control system. This opens up additional possibilities for intelligent heating and for even better, more convenient and more efficient temperature control at home.

For greater conservation of resources and more efficiency in the heating of the various rooms within one's own four walls, the room thermostat can be pre-ordered starting with the debut of the 2020 International CES.

Availability and recommended retail price of room thermostat
Bosch Smart Home Room Thermostat: €69.95
From January 2020 in Germany, Austria, France and Great Britain

Availability: integration of electric heaters
From spring 2020

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Press release

January 2, 2020
PI 11055 BBM ts/BT

Safety to the power of three: Bosch completes sensor portfolio for automated driving

Long-range lidar complements radar and camera

- Harald Kroeger: “By filling the sensor gap, Bosch is making automated driving a viable possibility in the first place.”
- Bosch technology covers all use cases of automated driving.
- Bosch’s long-range lidar sensor will be first solution suitable for automotive use.

Stuttgart, Germany /Las Vegas, NV, USA – Good things come in threes – and automated driving is no exception. Before safe automated driving can become a reality, a third sensor principle is needed in addition to camera and radar. Consequently, Bosch is making long-range lidar sensors production-ready – the first lidar (light detection and ranging) system that is suitable for automotive use. This laser-based distance measurement technology is indispensable for driving functions at SAE Levels 3 to 5. The new Bosch sensor will cover both long and close ranges – on highways and in the city. By exploiting economies of scale, Bosch wants to reduce the price for the sophisticated technology and render it suitable for the mass market. “By filling the sensor gap, Bosch is making automated driving a viable possibility in the first place,” says Bosch management board member Harald Kroeger.

Bosch technology is alert to all automated driving situations

Only the parallel deployment of three sensor principles ensures that automated driving will offer maximum safety when it is rolled out. This has been confirmed by Bosch analyses, where developers investigated all use cases of automated driving functions – from highway assist to fully automated driving in cities. For example, if a motorcycle approaches an automated vehicle at high speed at a junction, lidar is needed in addition to camera and radar to ensure the reliable sensing of the two-wheeler. In this instance, radar can struggle to detect the bike’s narrow silhouette and plastic fairings. Moreover, a camera can always be dazzled by harsh light falling on it. As such, there is a need for radar, camera,

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and lidar, with the three technologies complementing each other perfectly and delivering reliable information in every driving situation.

Lidar is an essential element in automated driving

We can think of laser as a third eye: in lidar systems, the sensor emits laser pulses and captures the laser light that is scattered back. The system then calculates distances based on the measured time it takes for the light to bounce back. Lidar offers very high resolution with a long range and a wide field of vision. As a result, the laser-based distance measurement tool can reliably detect even non-metallic objects at a great distance, such as rocks on the road. This means there is plenty of time to initiate driving maneuvers such as braking or swerving. At the same time, using lidar in vehicles exposes the lidar system's components, such as the detector and the laser, to many stresses – above all, with regard to temperature resistance and reliability over the vehicle's entire lifetime. Because Bosch can draw on its sensor expertise and systems know-how in the fields of radar and camera technology when developing the lidar, the company can ensure that all three sensor technologies dovetail with each other. "We want to make automated driving safe, convenient, and fascinating. In this way, we will be making a decisive contribution to the mobility of the future," says Kroeger. Bosch's long-range lidar will not only fulfill all safety requirements for automated driving, it will also enable automakers to efficiently integrate the technology into a very wide range of vehicle types in the future.

Artificial intelligence is making assistance systems even safer

Bosch is an innovation leader in sensor technology for driver assistance systems and automated driving. The company has been developing and manufacturing millions of ultrasound, radar, and camera sensors in-house for many years now. In 2019, Bosch sales of driver assistance systems rose by 12 percent to around 2 billion euros. These assistance systems are paving the way for automated driving. Recently, Bosch engineers succeeded in taking the camera technology used in cars to a new level by enhancing it with artificial intelligence. The camera technology detects objects, categorizes them into classes such as vehicles, pedestrians, or bicycles, and measures their movement. In congested urban traffic, the camera can also recognize and classify partially obscured or crossing vehicles, pedestrians, and cyclists quickly and reliably. This allows the vehicle to trigger a warning or an emergency braking maneuver as required. Bosch engineers are also continuously refining radar technology. The latest generation of Bosch radar sensors is even better at capturing the vehicle's surroundings – including in bad weather or poor light conditions. Their greater detection range, wide aperture, and high angular separability are the basis for this improved performance.

Press photos: #2913265, #2719199

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Bosch at CES 2020:

- **PRESS CONFERENCE:** In Ballrooms B, C, and D, Mandalay Bay Hotel, Las Vegas, **South Convention Center, Level 2**, from **9:00 to 10:30 a.m. local time on Monday, January 6, 2020.**
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Press release

BOSCH

December 5, 2019
PI 11049 BBM Fi/af

Camera-based life-saver: Bosch helps cars keep an eye on their passengers

More safety and convenience thanks to artificial intelligence

- The interior monitoring system detects driver drowsiness and distraction, and provides driving assistance
- Harald Kroeger: “Bosch is using cameras and AI to turn the vehicle into a life-saver.”
- Bosch is developing a new car-driver symbiosis for automated driving
- Over the next 20 years or so, new safety technology that e.g. warns drivers about drowsiness and distraction is expected to save 25,000 lives in the EU

Stuttgart, Germany – Microsleep, distraction, a seatbelt left undone – many things that happen inside a vehicle can have far-reaching consequences. To avert critical driving situations and possibly also accidents, it is planned that cars will in the future use their sensors not simply to monitor the road but also the driver and other passengers. For this purpose, Bosch has developed a new interior monitoring system featuring cameras and artificial intelligence (AI). “If the car knows what its driver and occupants are doing, driving will become safer and more convenient,” says Harald Kroeger, a member of the Robert Bosch GmbH board of management. The Bosch system may go into production in 2022. In that year, the EU will make safety technology that for example warns drivers of drowsiness and distraction a standard feature in new vehicles. The EU Commission expects that, by 2038, their new safety requirements for vehicles will save more than 25,000 lives and help prevent at least 140,000 severe injuries. By keeping an eye on what is happening inside the car, it is hoped that a fundamental problem of self-driving cars will be solved. If responsibility for driving is to be transferred to the driver again following an automated drive on the freeway, say, the car needs to be sure that the driver is neither sleeping, nor reading the newspaper, nor writing e-mails on their smartphone.

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A smart camera constantly monitors the driver

At 50 kph, a vehicle will cover 42 meters completely unsupervised if the driver dozes off or looks at their smartphone for just three seconds. Many people underestimate the associated risk. International studies state that nearly one in ten accidents are caused by distraction or drowsiness. This has prompted Bosch to develop an interior monitoring system that detects and alerts to this danger and provides driving assistance. A camera integrated in the steering wheel detects when drivers' eyelids are getting heavy, when they are distracted, and when they turn their head toward their passenger or the rear seats. Thanks to AI, the system draws the right conclusions from this information: it warns inattentive drivers, recommends a break if they are getting tired, or even reduces the speed of the vehicles – depending on the automaker's wishes, and also on legal requirements.

"Cameras and AI will turn the vehicle into a life-saver," Kroeger says. To achieve this, Bosch engineers have used intelligent image-processing algorithms and machine learning to teach the system to understand what the person in the driving seat is actually doing. To take the example of driver drowsiness, the system is trained using recordings of real driving situations and, on the basis of recordings of eyelid position and eye-blink rate, learns how tired the driver really is. This allows it to give an alert that is appropriate to the situation, and to use the driver assistance systems to intervene. Warning systems that sound the alert in the case of distraction and drowsiness will be so important in the future that NCAP, the European New Car Assessment Program, will include them in the roadmap for the Euro NCAP assessment for vehicle safety by 2025. On the subject of monitoring, only the software in the vehicle itself evaluates the information provided by the interior monitoring system – the information is neither saved nor passed on to third parties.

Like a relay race: responsibility for steering passes from car to driver and back

At the latest when cars start driving automatically, it is obvious how important it is that they understand their drivers. Once driving is automated, cars will drive along freeways without driver intervention. However, they will also have to be able to hand back control to their drivers in tricky situations such as construction zones, or when the exit ramp is drawing near. Drivers have to be able to safely take the wheel again at any time during the automated driving phase, and the camera makes sure they don't fall asleep. If their eyes remain closed for a prolonged period, an alarm is sounded. The system also interprets camera recordings to establish what drivers are currently doing, and how ready they are to respond. The transfer of driving responsibility is then timed accordingly. "Bosch driver observation will be essential for safe automated driving," Kroeger says.

When the car keeps its camera eyes open

But the new Bosch system keeps its eye not only on the driver, but also on all the other passengers, whether next to or behind the driver. For this purpose, a camera mounted above or below the rear-view mirror monitors the entire passenger compartment. It notices whether children on the rear seats have carelessly unfastened their seat belts, and warns the driver. If someone sitting in the back is leaning too far forward, at an angle, or with their feet up on the seat next to them, the airbags and belt tensioner will not be able to protect them properly in an accident. The interior monitoring camera can tell what position they are sitting in and set the airbags and belt tensioner to ensure the best possible protection. The interior monitoring system also prevents the passenger-seat airbag from being deployed if a baby's carrycot is on the seat. On the subject of children, it is a sad fact that parked vehicles can be a death trap for them. In the United States in 2018, they claimed the lives of more than 50 children (source: KidsAndCars.org), either because they had been left in the car for a short while or had clambered in unnoticed. The new Bosch system can recognizes this danger, and warn parents in a flash by sending a message to their smartphone. In an emergency, it also can alert the emergency services. As the Hot Cars Act currently being debated in the United States shows, legislators are interested in technology solutions to address this challenge.

A camera for more convenience

The new Bosch system also means more driving convenience. The interior monitoring camera can tell who is about to drive and adjust the rear-view mirror, seating position, steering-wheel height, and infotainment system to preset personal preferences. And the camera can also be used for eye- and hand-gesture control of the infotainment system.

Press photos: #2895919, #2895920, #2895921, #2895922, #2895923, #2895924, #2898068

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  Wednesday, January 8, 2020, 10:15 to 11:15 (local time)

  Event on the subject of "Growth of Apprenticeships for 'New Collar' Jobs" with Charlie Ackerman, Senior Vice President of Human Resources, Las Vegas, South Convention Center

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Press release
Bosch Sensortec

December 10, 2019
PI 11002 SM/HO

More than meets the eye: Bosch enables the next generation of smartglasses

Innovative Light Drive system for smartglasses creates the first transparent, lightweight, and stylish user experience

- World's first all-day transparency smartglasses solution
- Smallest Light Drive on the market: 30 percent less depth
- Highly efficient, lightweight system, weighing less than 10 grams
- Delivers high quality, bright images, even in direct sunlight
- Turnkey Light Drive display solution, for rapid integration
- Visit Bosch at CES®: LVCC, central hall, booth 12401

At CES® in Las Vegas, Nevada, Bosch Sensortec launches an innovative optical Light Drive system for smartglasses. The Bosch Smartglasses Light Drive module is a sole source, all-in-one technology stack consisting of MEMS mirrors, optical elements, sensors, and onboard processing. This integrated solution delivers a clean visual experience with bright images that are always in focus – even in direct sunlight.

The disruptive Bosch Light Drive technology revolutionizes all-day wearables with perceived total transparency for the user, and with radical social acceptance because it is nearly invisible to others. Additionally, the technology can also be applied to optimize performance of waveguide systems for which integration packages are in development.

There is no externally visible display or integrated camera, the two pitfalls that have alienated users of other smartglasses technologies. The smaller size allows designers to overcome the bulky, cumbersome characteristics of many of today's smartglasses. For the first time, a turnkey system enables smaller, lighter, more stylish smartglasses designs that meet the visual and comfort needs of everyone. The tiny module is also big news for those who wear eyeglasses for vision correction - a significant market, since six out of ten people use corrective lenses every day[1].

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"The Smartglasses Light Drive system is the smallest and lightest product on the market today and is, therefore, able to turn almost any regular spectacles into smartglasses," says Dr. Stefan Finkbeiner, CEO of Bosch Sensortec. "By eliminating distracting phone usage, smartglasses can help improve driving safety and reduce the impulse of users to constantly check their mobile devices for notifications or messages."

Bosch Sensortec's innovative Smartglasses Light Drive solution paves the way for a day without digital fatigue. The system displays the perfect balance of just-in-time hands-free information in a minimalist format, making it ideal for applications including navigation, calls, and notifications such as alarms, calendar reminders, and messaging platforms such as WhatsApp and WeChat. Everyday note-based information like to-do and shopping checklists are exceptionally convenient.

To date, these applications have been primarily restricted to devices with physical displays like smartphones or smartwatches. Smartglasses minimize socially unacceptable behavior such as obsessive phone checking, and help improve driver safety by providing hands-free, transparent heads-up navigation directions. The new technology promises to broaden the scope and availability of apps and information, coupled with instant access to relevant data, social media, and intuitive control of audio playback.

Innovative technology in a tiny package

A microelectromechanical system (MEMS) based collimated light scanner inside the Bosch Smartglasses Light Drive module scans a holographic element (HOE) that is embedded in the lens of the smartglasses. This HOE redirects the light beam onto the human retina surface, directly painting a picture that is always in focus.

The technology enables hands-free, secure viewing of practically any data from a connected mobile device, such as a paired smartphone, overlaid in a comfortable viewing position. The projected high-resolution image is crisp, bright, private, and clearly visible even in direct sunlight thanks to its adaptive brightness.

The Bosch Light Drive technology is compatible with curved and corrective lenses, making this new tech appealing and available to users who already wear prescription glasses. Older competitor display technologies are hindered by a haze or rainbow glare called stray light that is visible when the system is switched off. The Bosch Light Drive technology provides pleasing all-day optical transparency with minimal stray light sensitivity, meaning the view is always crystal clear, and that distracting internal reflections are a thing of the past.

Smallest Smartglasses Light Drive solution on the market

The new complete turnkey Light Drive system is the smallest comparable solution available on the market, delivering a depth reduction of 30 percent compared to existing solutions. It measures approximately 45-75 mm x 5-10 mm x 8 mm (L x H x W, depending on customer integration) and weighs less than 10 grams. This makes it easy for glasses manufacturers to flexibly reduce the width of the glasses frame to create a stylish design, and eliminate the visibly chunky design of first-generation smartglasses. Social acceptance and broad adoption have the potential to make retinal Light Drive technologies the next boom for manufacturers of consumer electronics display devices.

End-to-end solution for smartglasses manufacturers

Bosch Sensortec provides a turnkey Light Drive solution – designed and built in-house to ensure consistent high quality, reliability, and performance, whilst being able to quickly respond to market and customer demands for product modifications. Bosch Sensortec is the only end-to-end system provider of such retinal Light Drive technology and can further leverage this position by offering an extensive range of complementary devices and solutions. The smartglasses module is enriched by several sensor solutions, such as Bosch's smart sensor BHI260, the barometric pressure sensor BMP388, and the BMM150 magnetometer. The sensors enable intuitive user interface features such as multi-tap functions on the frame to improve convenience while operating the glasses.

The Bosch Smartglasses Light Drive solution will be available in 2021 to high-volume manufacturers as part number BML500P.

[1]Source:
Reference: "How Many People in the World Wear Glasses?". URL: https://www.reference.com/world-view/many-people-world-wear-glasses-e1268cfa00bdbd41 [05.11.2019].

Jan-Willem Bruggink (2013): "More than 6 in 10 people wear glasses or contact lenses". URL: https://www.cbs.nl/en-gb/news/2013/38/more-than-6-in-10-people-wear-glasses-or-contact-lenses [05.11.2019].

Press photo: #2719200, #2719201, #2719202, #2719203, #2719204, #2719205

YouTube: Watch the smartglasses solution in action: link

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Bosch at CES 2020:

- **PRESS CONFERENCE:** From **9:00 to 10:30 a.m.** local time **on Monday, January 6, 2020** in Ballrooms B, C, and D, Mandalay Bay Hotel, Las Vegas **South Convention Center, Level 2**
- **BOOTH: Tuesday to Friday, January 7–10, 2020**, in the Central Hall, booth #12401
- **FOLLOW** the Bosch CES 2020 highlights on Twitter: **#BoschCES**

- **PANELS WITH BOSCH EXPERTS:**
  Wednesday, January 8, 2020, 10:15 to 11:15 a.m. (local time)
  Growth of Apprenticeships for "New Collar" Jobs session with Charlie Ackerman, Senior Vice President of Human Resources, Las Vegas South Convention Center

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Bosch Sensortec GmbH, a fully owned subsidiary of Robert Bosch GmbH, develops and markets a wide portfolio of microelectromechanical systems (MEMS) sensors and solutions tailored for smartphones, tablets, wearables and hearables, AR/VR devices, drones, robots, smart home and IoT (Internet of Things) applications. The product portfolio includes 3-axis accelerometers, gyroscopes and magnetometers, integrated 6- and 9-axis sensors, smart sensors, barometric pressure sensors, humidity sensors, gas sensors, optical microsystems and comprehensive software. Since its foundation in 2005, Bosch Sensortec has emerged as the MEMS technology leader in the markets it addresses. Bosch has been both a pioneer and a global market leader in the MEMS sensor segment since 1995 and has, to date, sold more than 10 billion MEMS sensors.

For more information, please visit www.bosch-sensortec.com, twitter.com/boschMEMS, community.bosch-sensortec.com

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country in the world. The basis for the company's future growth is its innovative strength. At nearly 130 locations across the globe, Bosch employs some 68,700 associates in research and development.

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Press release

Bosch and Mercedes-Benz start San José pilot project for automated ride-hailing service

December 9, 2019
PI 11064 CC joe/Bär

- Bosch and Mercedes-Benz hope pilot automated ride-hailing project will provide additional insights for the development of automated driving
- Automated S-Class vehicles equipped with Bosch and Mercedes-Benz driving system and software provide shuttle service between West San José and downtown
- For its part, Bosch develops and manufactures the components for urban automated driving that the alliance has identified
- Daimler Mobility AG fleet platform allows ride-hailing partners to seamlessly integrate self-driving vehicles into their service portfolio
- San José contributes its urban infrastructure to the pilot project in order to enhance safety, environmental impact, and traffic flows

Stuttgart, Germany, and San José, CA, USA – Bosch and Mercedes-Benz's joint project to develop urban automated driving has now entered a new stage. Their pilot project for an app-based ride-hailing service using automated Mercedes-Benz S-Class vehicles has now been launched in the Silicon Valley city of San José. Monitored by a safety driver, the self-driving cars shuttle between West San José and downtown, along the San Carlos Street and Stevens Creek Boulevard thoroughfares. The service will initially be available to a select group of users. They will use an app developed by Daimler Mobility AG to book a journey by the automated S-Class vehicles from a defined pick-up point to their destination. Bosch and Mercedes-Benz hope this trial will provide valuable insights into the further development of their SAE Level 4/5 automated driving system. The partners also expect to gain further insights into how self-driving cars can be integrated into an intermodal mobility system that also includes public transportation and car-sharing.

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Bosch, Mercedes-Benz, San José – partners for the future of mobility

In mid-2017, San José was the first U.S. city to invite private companies to carry out field tests of automated driving and analyze the growing challenges in road traffic. Especially in congested city traffic, self-driving cars' permanent
360-degree surround sensing can potentially enhance safety, and their smooth driving style can improve traffic flow. As a city, we want to know more about how automated vehicles can help improve safety and reduce congestion, as well as make mobility more available, sustainable, and inclusive. The project of Mercedes-Benz and Bosch ties in with San José's extensive 'smart city' objectives. It will also help us develop guidelines for dealing with new technologies and prepare for the traffic system of the future," says Dolan Beckel, Director of Civic Innovation and Digital Strategy. "If automated driving is to become everyday reality, the technology has to work reliably and safely. And this is where we need tests such as our pilot project in San José," says Dr. Michael Fausten, head of engineering for urban automated driving at Robert Bosch GmbH. "It's not just the automated vehicles that have to prove their mettle. We also need proof that they can fit in as a piece of the urban mobility puzzle. We can test both these things in San José," says Dr. Uwe Keller, head of autonomous driving at Mercedes-Benz AG.

From August through November, representatives of the project joined staff from the City of San José to discuss the project with several community organizations. At seven meetings of neighborhood and business groups along the corridor, the team discussed the project goals, demonstrated the vehicle technology, explained the layers of safety redundancy built into the project, and took suggestions for future use cases.

Bosch and Mercedes-Benz partnering in the U.S. and Europe

For some two and a half years now, Bosch and Mercedes-Benz have been working together on solutions for automated driving in cities. Their common goal is an SAE Level 4/5 driving system for fully automated and driverless vehicles, including the software for vehicle management. However, they are not interested in prototypes, but instead want to develop a production-ready system that can be integrated into different vehicle types and models. In their work to develop software for controlling vehicle movement, the partners deliberately do not rely solely on artificial intelligence and clocking up test mileage. Their engineers also use simulations and specially designed proving grounds to specifically address the kind of driving situations that occur only very rarely in road traffic. For this purpose, engineers at the Immendingen testing and technology center in Germany can also make use of a 100,000 square-meter proving ground designed especially for automated driving. There, complex traffic situations can be reproduced extremely accurately, and as often as desired. For Bosch and Mercedes-Benz, thoroughness and safety are top priorities. In addition, their alliance is not exclusively concerned with the road and weather conditions in the United States. While one part of the team is based in Sunnyvale, a Silicon Valley city between San José and San Francisco, another part comprising engineers from both companies works in the Stuttgart area.

Alliance uses short decision-making channels and direct communication

Wherever they work, the Bosch and Mercedes-Benz associates sit desk to desk. This ensures short decision-making channels and rapid exchange across disciplines. And at any time, associates can draw on the knowledge and expertise of their colleagues in their parent companies. Here, Bosch know-how ranging from sensors, control units, and steering and brake control systems to entire automotive subsystems can be seamlessly complemented by Mercedes-Benz's long years of experience in systems integration and automaking. The division of labor within the project is no different. Mercedes-Benz's task is to make the jointly developed driving system ready for installation in the vehicle, and to provide the necessary trial vehicles, test bays, and test fleets. For its part, Bosch develops and manufactures the components for urban automated driving that the alliance has identified.

Platform allows integration of automated vehicles into taxi fleets

Specially for their automated ride-hailing service pilot project, Bosch and Mercedes-Benz have taken a further partner on board: Daimler Mobility AG is developing and testing a fleet platform to accompany the pilot operation phase. This allows potential ride-hailing partners to seamlessly integrate self-driving (Mercedes-Benz) vehicles into their service portfolio. The platform manages both self-driving and conventional vehicles, including operation and maintenance. An app-based mobility service for conventionally driven Mercedes-Benz vehicles went into operation in the Bay Area in the fall of 2019. The service is also available in the German capital Berlin.

Press photographs: **#**2898099, #2898100, #2898101, #2898102, #2898103

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Mobility Solutions is the largest Bosch Group business sector. In 2018, its sales came to 47.6 billion euros, or 61 percent of total group sales. This makes the Bosch Group one of the leading automotive suppliers. The Mobility Solutions business sector pursues a vision of mobility that is accident-free, emissions-free, and fascinating, and combines the group's expertise in the domains of personalization, automation, electrification, and connectivity. For its customers, the outcome is integrated mobility solutions. The business sector's main areas of activity are injection technology and powertrain peripherals for internal-combustion engines, diverse solutions for powertrain electrification, vehicle safety systems, driver-assistance and automated functions, technology for user-friendly infotainment as well as vehicle-to-vehicle and vehicle-to-infrastructure communication, repair-shop concepts, and technology and services for the automotive aftermarket. Bosch is synonymous with important automotive innovations, such as electronic engine management, the ESP anti-skid system, and common-rail diesel technology.

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Press release

BOSCH

New dimension: Bosch is paving the way for 3D displays in vehicles

Next milestone in digital displays

August 2019
PI 10982 BBM ts/af

- Dr. Steffen Berns, president of Bosch Car Multimedia: “Displays are increasingly becoming interactive systems.”
- Safer: 3D effect means visual information can be understood faster.
- More efficient: Bosch has combined all control functions in a central processing unit.

Hildesheim, Germany – Bigger, more visually attractive, and with more and more features, digital displays are becoming a key feature of vehicle cockpits. Neither drivers nor passengers want to be without the display and control features they now enjoy on devices such as smartphones and televisions. But there is more to it than that: in the cockpits of the future, digital displays will play a key role in the interaction between drivers and their vehicles. With its new 3D display products, Bosch is responding to this trend. The products use passive 3D technology to generate a realistic three-dimensional effect that allows visual information to be grasped faster than when displayed on conventional screens. “Displays are increasingly becoming interactive systems that can better anticipate drivers’ individual needs,” says Dr. Steffen Berns, president of Bosch Car Multimedia. “There is huge business potential for Bosch here.” Forecasts suggest that the global vehicle display market will double from 15 billion dollars (13.4 billion euros) to 30 billion dollars (26.7 billion euros) by 2025 (source: Global Market Insights). Whether curved, equipped with organic LEDS (OLEDs), or freely configurable – Bosch regularly sets the benchmark for vehicle displays.

3D effect in the cockpit

3D displays are the latest trend for vehicle cockpits. On the movie screen, a 3D effect serves primarily to enhance a film’s entertainment value. But in a vehicle, it’s a different case. “The display’s depth of field means drivers can grasp important visual information faster, whether from an assistance system or a

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traffic-jam alert," Berns says. "Alerts that seem to jump out of the display are much more obvious and urgent." When parking, moreover, the rear-view camera image is more realistic, allowing obstacles to be detected earlier. And drivers can get an even better idea of how much space they have left between the rear fender and, say, a parking garage wall. When navigating street canyons, this 3D effect also plays a decisive role, as the spatial depth of the map display makes it immediately clear which building marks the next turn. For its new display, Bosch makes use of a passive 3D technology, which works completely without additional features such as eye tracking or 3D glasses.

Innovative and interactive

The eyes are responsible for 90 percent of all human sensory perception. Simply showing information on a car display instrument is old hat. The future is all about interaction between users and displays. And Bosch is ready for this. Its portfolio includes applications of all kinds – from small and flat to large and curved, and sometimes in unusual shapes such as round or with trimmed corners. On top of this, interaction can take the form of voice or touch control – the latter also with haptic feedback. "Bosch is developing infotainment to suit any customer," Berns says. And especially when the drivers of the future let their autopilot do the driving, the human-machine interface (HMI) will be crucially significant for the interaction between the car and its driver.

Back-end makes all the difference

As displays grow in size, become more multi-purpose and intelligent, and feature voice and touch control, more and more computing power is needed. This could mean many more control units. Even now, as many as 15 back-end processing units control the display and operating systems. Bosch uses just one cockpit computer to coordinate the entire HMI, and delegates all control functions to one central control unit. "We are putting intelligence into the cockpit," Berns says. Fewer control units also means less weight, and vehicle development times are also reduced. Thanks to over-the-air updates, moreover, the infotainment system can be kept up to date just as simply as a smartphone.

Safety first

Vehicle displays are subject to rigorous safety standards. Especially when it comes to temperature fluctuations and vibrations, these standards are far higher than for consumer electronics. For example, car displays have to work perfectly whether the temperature is minus 40 or plus 120 degrees Celsius, and this over the vehicle's entire service life. Even in the event of partial failure, drivers have to be able to rely on a minimum amount of vital information at all times. Bosch operating systems are tested thoroughly to make them fit for vehicle use.

Since the 1980s, the company has repeatedly set milestones for vehicle display instruments, such as the world's first digital display, featured in the cockpit of the Audi Quattro. It was also thanks to Bosch that the first freely programmable display went into production in the Audi TT some five years ago. And Bosch is also behind the world's first curved instrument cluster in the Innovision cockpit of the latest VW Touareg. The company also applies its digital innovations to display instruments for motorcycles and e-bikes.

Press photos: #2715345, #1515914, #2715346, #1289439, #1289576, #2716453

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EXPERIENCE BOSCH AT THE IAA 2019 in Frankfurt: Rethinking mobility and making it as safe, emissions-free, and fascinating as possible – this is the goal Bosch has set itself. On a technological level, the supplier of technology and services wants to achieve these aims through personalization, automation, connectivity, and electrification. At the IAA 2019, Bosch will be presenting its latest solutions for making driving safer and more efficient, for making mobility available on demand, and for turning cars into personal assistants.

BOSCH PRESS CONFERENCE: From 12:55 p.m. to 1:10 p.m. CEST on Tuesday, September 10, 2019, with Dr. Volkmar Denner, chairman of the board of management of Robert Bosch GmbH and Dr. Stefan Hartung, chairman of the Mobility Solutions business sector, at the Bosch booth C02 in Hall 8.

FOLLOW the **Bosch IAA 2019** highlights at www.bosch-iaa.de and on Twitter: #BoschIAA

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