ARTIFICIAL INTELLIGENCE TECHNOLOGY IS THE FUTURE OF AUTONOMOUS AUTOMOBILE INDUSTRY

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ABSTRACT

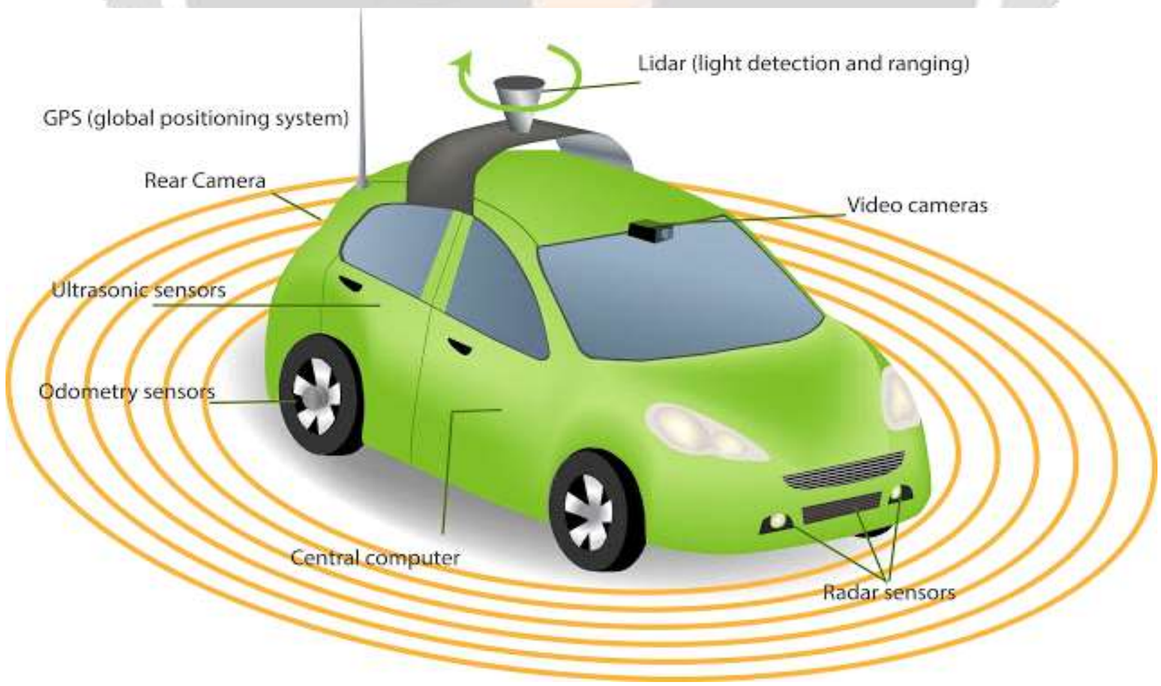
This paper explores the impact that has been working towards the goal of vehicles that can shoulder the entire burden of driving. Google driverless cars are designed to operate safely and autonomously without requiring human intervention. They won't have a steering wheel, accelerator or a brake pedal because they don't need them, software and sensors do all the work. It takes you where you want to go at the push of a button. This Technology step towards improving road safety and transforming mobility for millions of people.

Keywords :*Artificial Intelligence, Hardware Sensors, Google Maps, and Google Driverless Car*.

INTRODUCTION:

The next car probably will be autonomous. But, it will still have artificial intelligence (AI).

While most of the attention has been on advanced driver assistance systems (ADAS) and autonomous driving, AI will penetrate far deeper into the car. These overlooked areas offer fertile ground for incumbents and startups alike. Where is the fertile ground for these features? And where is the opportunity for startups?

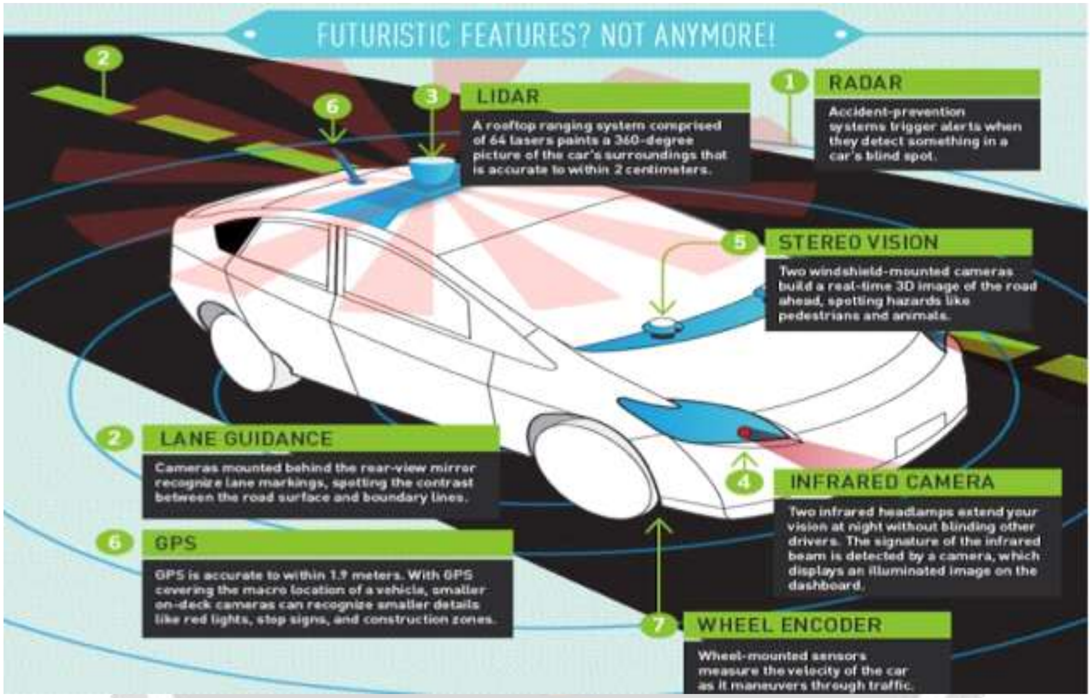


Autonomous Vehicles Defined:

- Vehicle that get from one point to another point without human interaction.

- Implement a number of well placed sensors that detect different things such as other vehicles, people, traffic lights, and movement of other vehicles.

The Technology of the Car :



- Systems(Audi)

- Infrared camera Anti-Lock Brakes.

- Electronic Stability control.

- Adaptive cruise control.

- Lane-departure warning system .

- Self parking .

- Automated guided vehicle systems.

- Lidar-Systems (with Google cars) or Cruise Automateds.

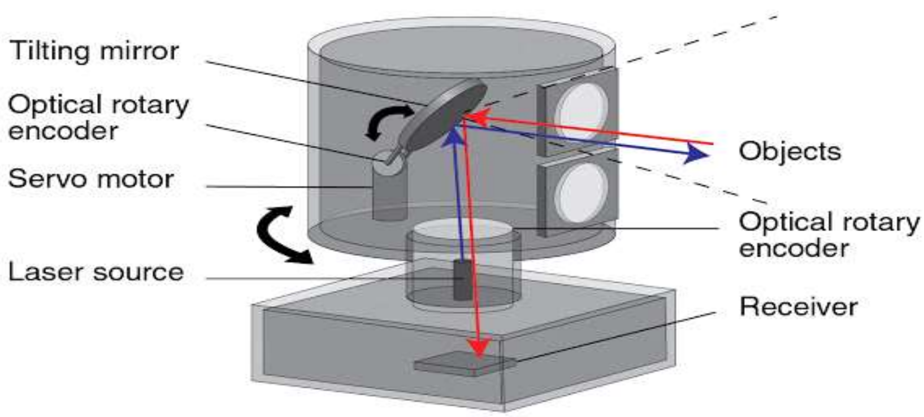
The Lidar System

Features:

- Vertical and horizontal setup of the system possible
- Image acquisition with fully integrated NIKON DSLR camera.
- 3D mode of the VZ scanner with continuous rotation of the scanning head for highly efficient mobile data acquisition.
- 360 degree static scanning.
- Mainly used by Google Inc. for detecting the surroundings of the vehicle

Cruise Systems

Features:



- Cameras and Radars to map out surroundings(including other vehicles)
- Used mainly for highway scenarios.

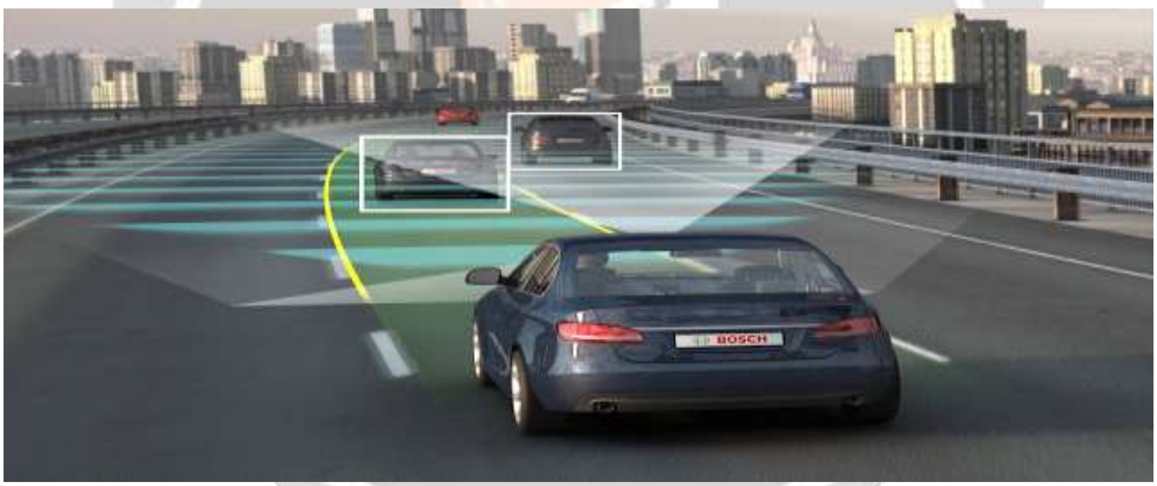
- Steering wheel motor mounted to steering column.
- Adaptive speed control.
- Collision avoidance
- RP-1 sensors
- Will be made in future for other vehicles.

Types of Algorithms

The combination of:

- 3-D imaging with multiple 1064 nm lasers.
- Edge-Detection Algorithm
- Motion-Detection algorithm
- Tracking algorithm

Components :



- Lane departure warning

o Lazy or inattentive drivers can automatically be moved

- Blind spot monitoring

o Warn if cars are in blind spots

- Pedestrian detection

o Automatic brake or warning

- Adaptive cruise control + forward collision warning :

o Car stays a safe distance behind cars ahead of it

o Warns or takes action in case of danger .

Public Acceptance and Adoption :

Vehicle to vehicle technology cannot function ideally without adoption across the board.

 Minority vs majority

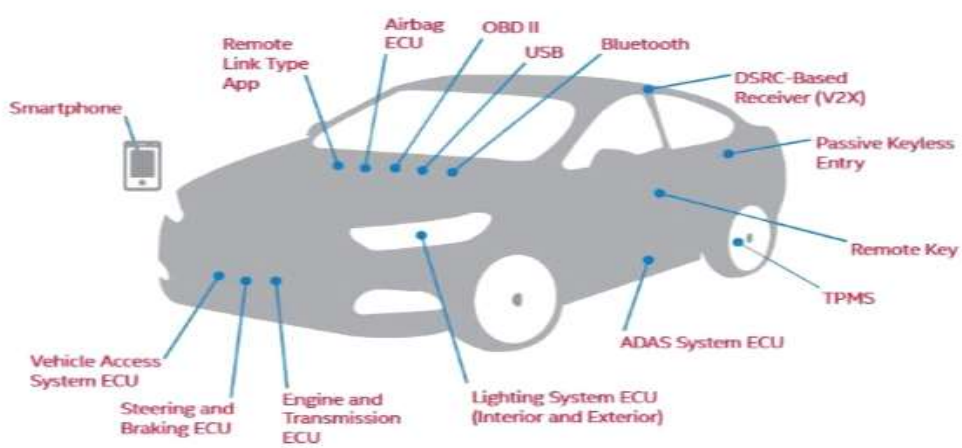
 Few legal precedents

o Legal in NV, CA, FL, MI, and the District of Columbia.

o Failed legislation in TX, OK, CO, AZ, OR, WI, and NH.

Cybersecurity :

Potential Attack Gateways:



• Electrical Control Units (ECUs)

• Airbag, Advanced Driver Assistant System, Engine, Steering & Brakes, etc.

• On-Board Diagnostics (OBD) II Diagnostic Port

• Dedicated Short-Range Communications-Based Receiver

• USB Ports • Passive Keyless Entry/ Remote Key

• Remote Link Type App

• Tire Pressure Monitoring System (TPMS)

Explanation of Key Attack Gateways :

• Electronic Control Units (ECUs) – ECUs are embedded systems that control one or more electrical systems or subsystems within a vehicle and are connected via an internal network. They control systems like the engine and transmission, steering and brakes, infotainment, lighting, etc. Risks arise when access to ECUs (usually peripheral ECUs like an infotainment system) are breached and malicious actors are able to access certain ECUs or the whole network. Vehicles today have up to 100 ECUs onboard.

• OBD II Diagnostic Port – Every car manufactured after 1996 and sold in the U.S. must have an OBD II installed. The port was originally mandated to permit monitoring of emissions, etc. It is increasingly used to facilitate non-diagnostic features like enabling WiFi, or enabling an insurance company to track usage through attachment of a "dongle" to the port. These ports can provide a means of access for attackers into an otherwise secure system.

• DSRC-Based Receivers – DSRC is being promoted as a means of encouraging V2V and vehicle-to-infrastructure (V2I) communications. The short-wave communications can be subject to spoofing and other attacks. There's now a push to move to more advanced 5Gbased communications.

Common Security Vulnerabilities :

• Software Glitches – Connected vehicles today contain more than 100 million lines of code. More code means more opportunity for bugs and mistakes. Glitches, even when inadvertent, can be exploited.

• No Single Source of Knowledge of or Control Over Source Code – Software for different components of connected vehicles is being written by different developers, installed by different supplies, and no one source has knowledge of or control over the source code.

• Increase Use of Apps Leave Vulnerabilities – Consumers are using an increasing number of smartphone apps to interface with their connected cars and help run certain functions. Researchers have already demonstrated weaknesses in some of these apps. Likely to see spread in use of malware.

• Need for Constant Updates May be Overlooked – With the increased use of connected features comes an increased need for continuous updates to fix glitches and help protect vehicles. There is a risk these updates could be overlooked or that malicious actors could infect routine updates.

Cybersecurity Threats and Concerns :

• The same types of attacks that are possible in any connected device are generally possible in connected vehicles once access is gained.

• For example – Denial-of-service (DoS) attacks (e.g., utilizing the Controller Area Network (CAN) Bus system), remote access and control (e.g., the 2015 Jeep event), man-in-the-middle (MiM) attacks, etc.

• The difference between attacks like these against common IoT devices and attacks within a connected or autonomous vehicle is the likelihood for increased risk to life and property in the vehicle context

Consumers Desire and Fear Connectivity :

In 2014, McKinsey conducted a survey of 2,000 new-car buyers in Brazil, China, Germany, and the U.S. about connected car issues. The survey remains interesting for the disjoint it highlights between consumer desire for connectivity and consumer fear of the possibility of attacks as a result of that connectivity.

• 13% of car buyers are no longer prepared to even consider a new vehicle without Internet access.

• More than ¼ of car buyers now prioritize connectivity over features like engine power and fuel efficiency.

• 45% of U.S. car buyers are reluctant to use car-related connected services because they want to keep their privacy.

• 43% of U.S. car buyers are afraid that people can hack into their cars and manipulate the systems if the car is connected to the Internet.

Key Cybersecurity Takeaways:

• Provide Multi-layered protection – Beginning at level of individual ECUs, moving up a level to include software to protect vehicle's internal network by examining all network communications, and building in mechanisms to stop attacks from advancing within network.

• Defend against externally-facing potential gateways – Ensure weakest links in car's security are viewed as potential threats and defenses are built into system. This is particularly true to infotainment or similar externally-facing mechanisms that are developed or utilized by multiple external entities.

• Ensure vendors and suppliers have strong security – Connected and autonomous vehicles are made up of subparts and subsystems. It is critical to review and monitor vendor and supplier policies and practices.

• Promote timely updates – Companies should push timely and effective fixes as soon as problems are identified.

Data Privacy :

Privacy Concerns:

"GPS monitoring generates a precise, comprehensive record of a person's public movements that reflects a wealth of detail about her familial, political, profession, religious, and sexual associations. . . . I would take these attributes . . . into account when considering the existence of a reasonable societal expectation of privacy in the sum of one's public movements."

"it may be necessary to reconsider the premise that an individual has no reasonable expectation of privacy in information voluntarily disclosed to third parties. This approach is ill suited to the digital age, in which people reveal a great deal of information about themselves to third parties in the course of carrying on mundane tasks."

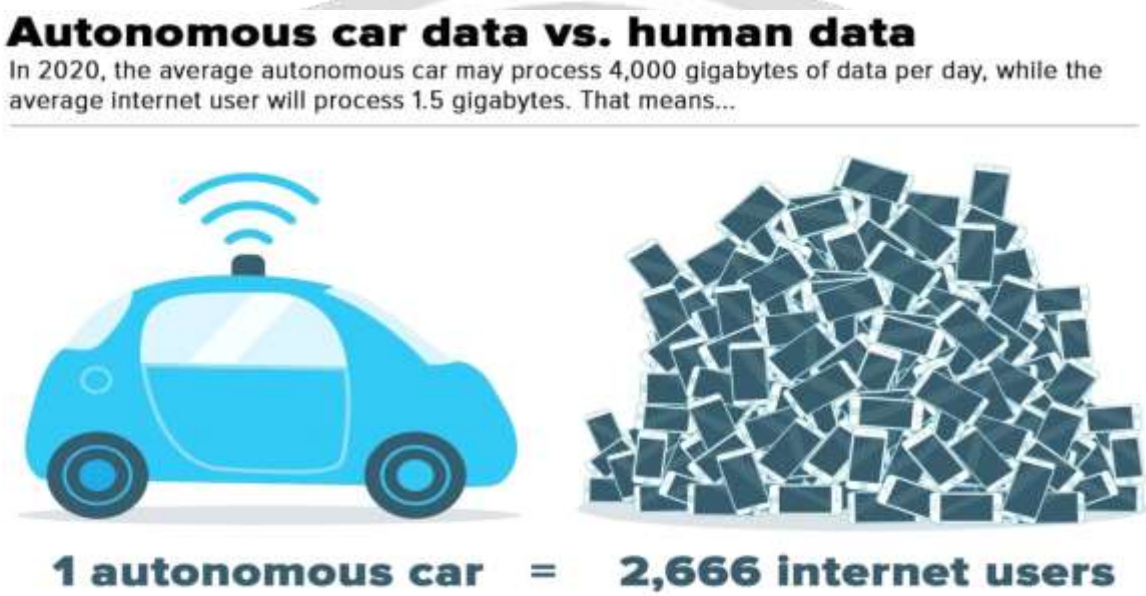
Common Data Privacy Vulnerabilities

• Data related to vehicle journeys – Car makers, app developers, on-board assistance systems, etc. collect data regarding movements of vehicle. Length of time data is kept, who has access to it, and whether consumer has right to opt-out are key issues.

• Data on consumer habits and preferences – Data ranging from music preferences, news and radio selections, and other features is being used to target consumers. How this is done and whether consent is obtained will dictate potential ramifications.

• Data from or related to children – Collection, use, and storage of children's data is governed by special rules which should be considered.

• Differences in regulations between markets – Privacy regulations vary widely by region and market. For example, the EU is set to implement its groundbreaking data privacy and protection law, the GDPR, this May. The law includes a broad definition of personal information and strict requirements for consent and use and protection of such data. Companies working in the European market need to be prepared.



Inside the cabin:

Inward-facing AI cameras can be used to prevent accidents before they occur. These are currently widely deployed in commercial vehicles and trucks to monitor drivers to detect inebriation, distraction, drowsiness and fatigue to alert the driver. ADAS, inward-facing cameras and coaching have shown to drastically decrease insurance costs for commercial vehicle fleets.

The same technology is beginning to penetrate personal vehicles to monitor driver-related behavior for safety purposes. AI-powered cameras also can identify when children and pets are left in the vehicle to prevent heat-related deaths (on average, 37 children die from heat-related vehicle deaths in the U.S. each year).

Autonomous ridesharing will need to detect passenger occupancy and seat belt engagement, so that an autonomous vehicle can ensure passengers are safely on board a vehicle before driving off. They'll also need to identify that items such as purses or cellphones are not left in the vehicle upon departure.

AI also can help reduce crash severity in the event of an accident. Computer vision and sensor fusion will detect whether seat belts are fastened and estimate body size to calibrate airbag deployment. Real-time passenger tracking and calibration of airbags and other safety features will become a critical design consideration for the cabin of the future.

Beyond safety, AI also will improve the user experience. Vehicles as a consumer product have lagged far behind laptops, tablets, TVs and mobile phones. Gesture recognition and natural language processing make perfect sense in the vehicle, and will make it easier for drivers and passengers to adjust driving settings, control the stereo and navigate.

Under the hood:

AI also can be used to help diagnose and even predict maintenance events. Currently, vehicle sensors produce a huge amount of data, but only spit out simple codes that a mechanic can use for diagnosis. Machine learning may be able to make sense of widely disparate signals from all the various sensors for predictive maintenance and to prevent mechanical issues. This type of technology will be increasingly valuable for autonomous vehicles, which will not have access to hands-on interaction and interpretation.

AI also can be used to detect software anomalies and cybersecurity attacks. Whether the anomaly is malicious or just buggy code, it may have the same effect. Vehicles will need to identify problems quickly before they can propagate on the network.

Cars as mobile probes:

In addition to providing ADAS and self-driving features, AI can be deployed on vision systems (e.g. cameras, radar, lidar) to turn the vehicle into a mobile probe. AI can be used to create high-definition maps that can be used for vehicle localization, identifying road locations and facades of addresses to supplement in-dash navigation systems, monitoring traffic and pedestrian movements and monitoring crime, as well as a variety of new emerging use cases.

Efficient AI will win:

Automakers and suppliers are experimenting to see which features are technologically possible and commercially feasible. Many startups are tackling niche problems, and some of these solutions will prove their value. In the longer-term, there will be so many features that are possible (some cataloged here and some yet unknown) that they will compete for space on cost-constrained hardware.

Making a car is not cheap, and consumers are price-sensitive. Hardware tends to be the cost driver, so these piecewise AI solutions will need to be deployed simultaneously on the same hardware. The power requirements will add up quickly, and even contribute significantly to the total energy consumption of the vehicle.

It has been shown that for some computations, algorithmic advances have outpaced Moore's Law for hardware. Several companies have started building processors designed for AI, but these won't be cheap. Algorithmic development in AI will go a long way to enabling the intelligent car of the future. Fast, accurate, low-memory, low-power algorithms, like XNOR.ai* will be required to "stack" these features on low-cost, automotive-grade hardware.the next car will likely have several embedded AI features.

The very idea of a driverless vehicle rolling around on the streets seems incredible. And yet, we may be close to seeing such vehicles on the road around the world, thanks to artificial intelligence (AI), among other driving forces. In the recent past, there have been some amazing advances in autonomous vehicle technology which indicate the dream is inching toward fruition. It seems that the framework of autonomous vehicles has been almost finalized. Subject to legal and administrative approvals, driverless vehicles will be a common sight on the roads soon. (To learn about other automotive advancements, check out 5 Ways Our Cars Have Become Computers.)

1.Delivery Vehicles:

You have seen delivery vehicles driven by humans delivering packages. Now, we could see the same task done by driverless vehicles – and with higher efficiency and swiftness. Nvidia, the leading computer graphics provider, Deutsche Post DHL Group (DPDHL), the world's biggest mail and logistics company, and ZF, an automotive provider have teamed up to deploy driverless electric light trucks which will transport and deliver packages. The driverless trucks will deliver packages from a central point to the destination. In the interim, it is trained to accurately assess its environment for variables such as traffic conditions, parking spot identification and parking, and pedestrian behavior. The truck is powered by the ZF ProAI self-driving system, which is powered by the Nvidia

DRIVE PX palm-size supercomputer, but it also includes sensors, cameras, LIDAR and radar that feed the data into the system. Note that apart from the obvious benefit of relentless accuracy and no driver fatigue that the technology promises, there is also the potential of huge cost savings because the process of delivering packages from the central point to the destination is the most expensive for logistics companies.

2.Full Autonomy:

Imagine luxurious driverless taxis that help passengers move between points. You can just do your thing – watch a movie, work on your laptop or listen to music – and not have to worry about the taxi safely taking you to your destination. Such taxis could soon become a reality. Nvidia's DRIVE PX AI platform is going to usher in fully autonomous vehicles. The DRIVE PX AI platform is 10 times superior to its predecessor DRIVE PX 2 and can handle over 320 trillion operations per second. This means the car will be learning and making accurate decisions about its environment on the road much faster than its predecessors.Currently, Tesla cars are equipped with the necessary hardware for autonomous driving, but software updates are required to fully enable the feature. While it will allow fully autonomous driving, it will also still allow the human driver to take control, when necessary. The next generation of autonomous vehicles would not need steering wheels, pedals or transmissions. Such cars will potentially reduce accidents, will be viable transportation options for the elderly or those with vision or physical disabilities, and could increase productivity.

3.Parking:

Car parking is not really a novel development. The advent of automated parallel parking is probably among the earliest of AI exploits in autonomous driving technology. However, the concept has greatly evolved in recent years. Parking, especially in big cities, is a major problem because it increases emissions, wastes time and productivity, and increases stress. Bosch has developed a smart AI-based system that provides data on available parking spots, locations and times to park. The car even does the parking itself without any accidents. As the car is on the move, it receives information about parking availability at places closest to its GPS location. The parking space data is sent to many cloud servers from cars, which is then sent back to cars so that drivers can learn about parking space availability.

4.Cars with Common Sense:

While work on the autonomous driving domain has seen amazing advancements already, common sense like that of human drivers has been the missing piece in the developments. In difficult traffic conditions, especially in big and chaotic cities, the human mind is highly sensitive to constantly changing variables such as fellow drivers' attitudes, pedestrian behavior and erratic weather. It is critical for the driverless car to develop a human-like common sense on the streets. An MIT spinoff, known as iSee, has been working on AI and deep learning to impart common sense into driverless cars. This is going to be the most significant component of the autonomous vehicle initiative. The iSee team has been working hard on data and neural networks so that cars can learn from data and negotiate any and all types of traffic conditions. According to Yibiao Zhao, co-founder of iSee, "The human mind is super-sensitive to physics and social cues. Current AI is relatively limited in those domains, and we think that is actually the missing piece in driving." (For more on deep learning, see A Tour of Deep Learning Models.)

5.Cars with Peripheral Vision:

Knowledge of pedestrians, objects or vehicles around a blind corner is a critical factor in safe driving. Blind spots have been responsible for many accidents. A new AI technology enables cars to view and assess the distance and speed of pedestrians, objects or vehicles around a blind corner. CornerCameras, an AI initiative by MIT researchers at the Computer Science and Artificial Intelligence Laboratory (CSAIL) enables driverless cars to identify people or objects situated in blind corners of the roads. The technology uses light reflections and does not actually see objects or people. From the data received, it can direct the self-driving car for a better driving experience. According to Katherine Bouman, the lead author of the paper detailing the system, "Even though those objects aren't actually visible to the camera, we can look at how their movements affect the penumbra to determine where they are and where they're going."

Conclusion:

These developments are exciting news and are expediting the arrival of the fully autonomous car. However, before we see autonomous cars on the road across the globe and it is treated as a normal phenomenon, two things will be key: one, the imparting of common sense in driverless cars, and two, clearance of the various legal and insurance hurdles on the way.

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