

Modern and Upcoming Technological Trends in Automobile Industry

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Abstract- Various sectors have experienced unprecedented growth as a result of the creative introduction of Artificial Intelligence and Machine Learning technologies. Businesses are utilizing these technologies to fulfil their corporate objectives as well as customer happiness by giving them with a variety of high-quality alternatives in what they desire. Simply said, technology aids firms in distinguishing themselves from their competitors while also enhancing production and efficiency. Many business leaders believe that the advent of new breakthrough technology will be the catalyst for a paradigm change in the industry.

We shall analyze and explore present and forthcoming technology developments in two focused sectors in this research paper. Automobile manufacturers such as Tesla, Voyage, AutoX, and others are employing technology such as Artificial Intelligence, Machine Learning, Big-Data Analysis, and others to make their vehicles more comfortable and more suited to the demands of its customers. Moreover, the combination of database management systems, expert systems, artificial intelligence, and the Internet of Things has greatly simplified and alleviated industrial tasks. In the future, technological advancements will have a big impact on all of these businesses, as they will not only make things more accessible, but also enhance the technology-human interaction and user experience.

The aim of this paper is to highlight and interpret the current and upcoming technological trends in these three industries. This paper also aims to examine and understand how incorporation of these technologies in these industries help them achieve their business goals, and how these businesses take advantage of these technologies to their best extent. As the category of this paper is Information Technological tools, the paper, rather than focusing on the business aspects of these tools, will be more focused on the technological parts of various industries.

1. INTRODUCTION

To create creative solutions, the automotive industry has a fantastic combination of tech and industrial sector innovators. With the digitalization craze sweeping the globe, the automobile sector is gearing up for a major transformation in 2021. In the last decade, the industry has witnessed a lot of ups and downs. However, as more

technology is adopted in many sectors, the car business is continually progressing, allowing industrialists to earn more money and end-users to discover more novel driving approaches. Furthermore, as McKinsey predicted in 2016, the car business is progressively transitioning to the future age, in which manufacturers will generate more income and users will enjoy novel driving solutions. In the last 10 years, the industry has undergone extraordinary ups and downs. Because of the Covid-19 epidemic, 2020 was a quiet year, with few people purchasing automobiles. However, the industry is beginning to recover, giving everyone reason to be optimistic. They've become more streamlined, safer, and capable of reaching faster speeds. The automobile sector is preparing for a massive transformation in upcoming years, because to the world's rapid digitization.

Customer experience is being elevated to new heights by digital behemoths like Netflix, Amazon, and Booking.com. Customers have grown used to clear pricing, one-click access, and quick delivery across online and physical venues. Customers expect the same thing from autos. Selling automobiles at transparent rates, one-click access to in-car services, and making seamless online-offline trips are just a few examples. The market's newcomers are succeeding because they are developing customer-centric business and sales approaches. According to a survey of such new market actors, they do not seek to offer automobiles but rather mobility. The automobile sector, as well as the domain's sub-branches that fall under its umbrella, can benefit from the usage of such innovative and user-friendly technology.

If we move over to the current industrial positionings, China, like other industries, leads in the vehicle sector, followed by the United States and Japan. The automobile sector, on the other hand, is changing with the passage of time and circumstances such as demand for auto sector products and the nation's average age. Since 2019, India has ranked fourth as the world's largest vehicle market, surpassing Germany, and forecasts indicate that it will soon overtake Japan to become the third largest market. China will lead the car sector by 2030, according to the sources, followed by the United States and India. The Indian automobile sector (including component manufacturing) is predicted to reach Rs. 16.16-18.18 trillion (US\$ 251.4-282.8 billion) by 2026, according to IBEF estimates.

1.1 Artificial Intelligence in Automobile

Artificial intelligence (AI) is a technology that combines data and algorithms to mimic human decision-making and reasoning abilities. Artificial intelligence adoption in the automobile business is lower than in the Financial Services, ICT, Retail, and Healthcare sectors. The automobile sector may be classified as "new adopters" in terms of AI technology adoption and application. Artificial intelligence has a wide range of applications in the automobile industry. AI is now being used in the automobile industry, in areas such as design, supply chain, production, and post-production. Furthermore, AI is being used in 'driving assistance' and 'driver risk assessment' systems, which is revolutionizing the transportation industry. Artificial intelligence is also revolutionizing aftermarket services such as predictive maintenance and insurance. The automobile sector is now undergoing a massive upheaval. To keep one step ahead of their market competition, ambitious manufacturers have begun incorporating sophisticated technology into their products and operations.

Automotive Value chain Contains three areas where AI is applied. This includes parts like:

- Manufacturing
- Transportation
- Service
- Manufacturing

With the aid of artificial intelligence (AI), robots are acquiring automobile manufacturing skills (design, part manufacture, and assembly). Artificial intelligence (AI) offers applications across the automobile factory floor. Currently, AI assists people in the development of automobiles utilizing Exoskeletons; in the future, these AI-powered robots will be able to control the entire factory. Automakers may utilize AI-driven systems to establish timetables and manage workflows, allowing robots to safely operate alongside people on factory floors and assembly lines, and detecting flaws in components that go into cars and trucks. These skills can assist firms minimize production line costs and downtime while also providing better final products to customers.

Example of this includes:

In its North American factory, Hyundai debuted AI-powered wearable robots.

- Hyundai conducted a North American production test of the Hyundai Chair less Exoskeleton (H-CEX) in October 2018.
- Using robotic and AI technologies, the business has created wearable robots, service robots, and micro mobility. Robots to charge electric automobiles and robots to sell autos are among the company's plans.

- The plant's productivity will be improved by the exoskeleton. This will assist to reduce tiredness by 80 percent by lowering the utilization of waist and lower body muscles.

The OTTO motors AI-powered material handling system was introduced.

- Otto Motors, a US-based start-up (part of Clear path Robotics) introduced an intelligent material delivery vehicle for industrial facilities in October 2016. To man oeuvre autonomously around a manufacturing plant, an intelligent vehicle uses AI (Self-learning Technology).
- The company's self-driving car is being updated on a regular basis. It released a self-driving material handling truck with a payload of 750kg in 2018.
- This vehicle increased manufacturing facility output capacity while reducing accidents.
- Transportation

The transportation industry is being transformed by artificial intelligence. AI is currently playing an important part in driver aid technology and is widely deployed in modern automobiles. Tesla currently offers level 2 autonomous vehicles, with plans to introduce level 4/5 autonomous vehicles by the end of 2020. AI may be used to monitor a driver's eye to see if he or she is napping or weary. AI systems alert drivers to hazardous road conditions, monitor blind spots in the driver's view, assist with steering, and take automated actions to help vehicles avoid accidents and dangerous situations, thanks to advanced driver-assist features, many of which are available in today's cars and trucks.

Example of this includes:

Tesla's Model S automobile now has autopilot functionality.

- Tesla's 'Autopilot Driver Assistance System' with autopilot functionality for its Model S automobile was released in October 2015.
- The business is constantly upgrading its software in order to increase self-driving capability and passenger safety. Aside from that, the business created AI chips in-house to boost the car's performance and safety.

NEXYAD created software that assesses driving danger in real time.

- The business created an AI-powered solution in 2016 that calculates a real-time risk assessment of the driver.
- The program calculates the risk 20 times per second and alerts the driver in order to prevent a potentially dangerous situation.
- Services

Artificial intelligence (AI) has the potential to play a key role in aftermarket servicing. Many AI apps now forecast engine performance, better battery life, and other issues that may arise in the future. Furthermore, several AI-powered insurance companies provide consumers with speedy services, such as insurance and claim settlements. AI can also assist in the prediction of automotive component failures. This allows production processes to operate at peak efficiency, saving time and money in the long term.

Automotive solutions based on AI and Deep Learning can provide a wealth of useful in-car analytics. Cameras and infrared sensors can precisely monitor the driver's activity and send out warning messages to prevent accidents.

Road conditions may also be detected in real time by AI-powered vehicle applications, allowing drivers to be informed of construction work, accidents, speed restrictions, and road closures before they begin their journey.

This information is especially useful for commuters in cities where traffic congestion and road works are common.

Example of this includes:

Predii is a platform that uses artificial intelligence to forecast maintenance needs.

- In 2017, Predii (an AI software firm located in Palo Alto, CA) launched an intelligent platform for automobile part replacement and maintenance.

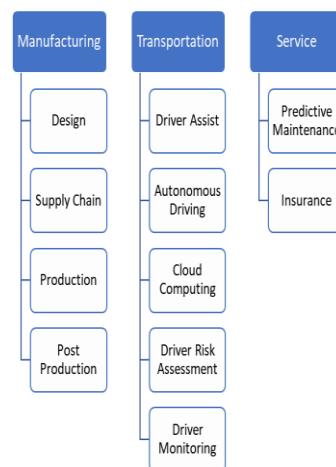
- For car repair and maintenance, this intelligent platform uses past service data (such as service orders, IoT data, and technical manuals).

Autonomous vehicles have been more popular in recent years, and with good reason: most automakers regard the race to Level 4 vehicle autonomy (high driving automation) as critical to their future success in the mobility industry. Self-driving technology is projected to reduce greenhouse gas emissions, the number of accidents, transportation and travel time and expenses, among other things. The Mercedes-Benz S-Class of 2021 comes with all of the technology necessary for Level 4 (de facto self-driving), bringing this level of autonomy closer to reality.

For navigation and control. To make day-to-day transportation easier, autonomous cars are designed to minimize the need for human drivers. Uber, Tesla, and Google are among the major industry companies who are actively attempting to improve the reliability of autonomous vehicles. With the present rate of development, it is expected that more applications will be investigated, and investments will be made in the next years.

Another AI application that has sparked a lot of attention is driver monitoring. Analysis of a driver's vital signs, eye movement, and behavior to determine attentiveness and

other characteristics might help prevent accidents, making it a major field of research and development for automakers. Aside from real-time risk assessment, AI can also aid in the development of predictive maintenance in future automobiles. As AI becomes more commonly used, new applications for this smart technology in the mobility industry are expected to emerge.



(Figure 1- AI in automotive value chain, Source: Future Bridge Analysis and Insight)

1.2 Machine Learning and Data Science in Automobile

Machine learning (ML) is most commonly connected with product advancements in the automobile sector, such as self-driving vehicles, parking and lane-change aid, and smart energy systems. Machine learning and Data science usually goes hand in hand due to their nature, data science and big data analysis is necessary when dealing with autonomous vehicles. The huge chunks of data from the cars are collected in the database where they are analyzed and become helpful for cars to run safely on road. However, when it comes to marketing function machine learning have a huge impact, from how automotive marketers set targets and analyze returns on investments to how they communicate with customers. For smart marketing efforts across sectors, machine learning is set to become as much an organizational principle as an analytic element. This is especially true in the automobile industry, which is a capital-intensive, high-tech business that has been driven by competition.

Advanced data analytics informs various choices during a vehicle's life cycle when huge data is generated. The data acquired from the cars is used to qualify predictive maintenance, warn authorities in the event of an emergency or an accident, and notify fleet management. Car manufacturers can use predictive analysis to make judgments about their yearly sale purchases and production targets. Additionally, client automobile data is used by the app to optimize supply chains, drive more sales, and improve the product design of impending new vehicles.

Example of this includes:

- Industrial Analytics - In the manufacturing value chain, analytics has shown to be a very strong tool. It is critical to evaluate and gather data from many functions across the industrial life cycle in order to fully exploit the promise of data science. This means that having an end-to-end analytics approach that includes workforce analytics, asset/inventory management, and operational planning is critical for creating insights.
- Vehicle Maintenance Recommendations - Machine learning algorithms may be used to deliver developing vehicle maintenance recommendations to drivers. It is possible to forecast when an event or issue will occur again based on previous occurrences.
The data acquired by a vehicle's sensors, for example, might suggest progressive overheating, friction, or noise. These faults may also cause a specific car part to fail in the future. The machine learning system tracks these occurrences on a regular basis and analyses the frequency with which they occur. Based on the data, it also properly forecasts when the vehicle or item will break down.
- Usage of data science in Automotive Lifecycle

The Model T was introduced in 1908 and has remained popular because to its low cost, durability, adaptability, and ease of maintenance. It is credited with "setting the globe on wheels," bringing global mobility to the masses through manufacturing efficiency at a cost that the typical person could afford.

The automobile sector is still on the cutting edge of technology and is revolutionizing how people move from point A to point B today. The significant difference, according to Michael Crabtree, Lead Data Scientist at Ford Motor Company, and instructor of our course Credit Risk Modeling in Python, is that its innovation is now driven by data science rather than manufacturing, as he explained in a recent webinar.

"Innovation at Ford is now driven by data science—not manufacturing." [1]

Data science is scaling mobility for lower-income areas today, just like the industrial scalability of the Model T delivered mobility to the public over 100 years ago. It makes transportation more accessible without imposing a large ownership cost, and it is facilitating this transition for everyone, regardless of class, gender, or ability.

Optimization algorithms, for example, can supply companies with energy-efficient trucks to service rural populations for everything from Amazon deliveries to plumbing and food deliveries. Vehicles that aid differently abled populations are

being developed in collaboration with data scientists and reliability engineers.

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- Integration of Data science and DBMS in Automotive industry

Because of the maturity and breadth of the automotive sector, there are several chances for firms to rebuild around data.

One application manages data from several data systems and data kinds. Many data scientists are used to working with tabular data, which is data organized in a table style similar to Excel. Automotive data scientists, on the other hand, have a considerably wider range of data to work with. In the automobile sector, for example, raw instrumentation data is frequently recorded as a stream of hexadecimal numbers. They may also come across photos and sensor point clouds containing data from intelligence systems. An automotive data scientist could merge point clouds with sensor data and link it to a collection of tables to determine why an autonomous car performs a specific way and how it differs among vehicle types.

Volume is another possibility: Michael's largest database at Ford has 80 billion records and responds to requests in less than 10 seconds! The automobile industry's real-time and transactional systems handle about 150 million records every day. Because there is so much data created in the automobile industry, relatively big data clusters are required. Data clusters in the petabyte (million gigabytes) level are common in the automobile sector, which is a huge chunk of data!

- Data Science's involvement in Product Development

Before a car may be sold to a consumer, there are several stages that must be completed. In the automobile industry, data science begins with product development. Data science is used to analyze original model configurations and model component part dependability, among other things. Data science supports the process by simulating and analyzing data at scale, rather than developing components and testing at each level as a separate system.

- Data Science drives manufacturing process

Data scientists in the automotive industry also guarantee that only high-quality automobiles are marketed. While engineers are capable of verifying each car's quality, this must be done on a case-by-case basis for each vehicle. Data scientists can examine a large number of parts, suppliers, and test results. They examine suppliers' financial performance, estimate their capacity to deliver on time based on previous performance, and verify the economic conditions of supplier regions using econometrics and regressions.

Example of this includes:

- Procon Analytics - Procon Analytics is a firm established in the United States that uses big data to deliver an automobile finance solution. The service collects and inspects millions of data points in real time, allowing lenders to access them quickly and reduce risk. Buy Here Pay Here (BHPH) dealers can use this corporation to develop their companies and extend financing to high-risk consumers. It also offers software solutions for asset and fleet tracking, as well as linked vehicles.

Unit8 - Unit8 is a Swiss business that provides digital solutions in a variety of sectors utilizing analytics and big data. In the case of automotive, the firm develops a predictive model that motivates automakers to improve marketing or operations, ultimately increasing revenue. These models also provide information on product pricing, construction, and after-sales support.

1.3 Blockchain technology and IoT in Automotive Industry

Bitcoin and cryptocurrencies have long been connected with blockchain technology. As we see many more industry participants adopting blockchain and its limitless possibilities, this mindset is fast dissipating. The automobile sector is not far behind in realizing blockchain's full potential. On the other hand, Internet of Things (IoT) has opened up new opportunities for carmakers and purchasers all around the world. IoT in the automobile industry has become a key hotspot for a variety of multi-purpose applications, with use at both an industrial and commercial level. The Internet of Things applications have made a significant impact on the worldwide automobile business, from linked cars to automated transportation systems.

Before we explore the functions and applications of these technologies in the industry, let's first understand what these technologies are. Starting with the Blockchain, it is a decentralized database that is shared across computer network nodes. A blockchain acts as a database, storing information in a digital format. Blockchains are well recognized for their critical function in keeping a secure and decentralized record of transactions in cryptocurrency

systems like Bitcoin. The blockchain's novelty is that it ensures the accuracy and security of a data record while also generating trust without the requirement for a trusted third party. The structure of the data on a blockchain differs from that of a traditional database. A blockchain organizes data into groupings called blocks, each of which contains a collection of data. Blocks have specific storage capabilities, and when they're full, they're closed and connected to the preceding block, producing a data chain known as the blockchain. All additional information added after that newly added block is compiled into a new block, which is then added to the chain after it is filled.

On the other side, The Internet of Things (IoT) is a network of physical items that have sensors, software, and other technologies integrated in them for the purpose of communicating and sharing data with other devices and systems through the internet. These devices range in complexity from common household items to sophisticated industrial instruments. Experts predict that by 2020, there will be more than 10 billion linked IoT devices, and by 2025, there will be 22 billion.

IoT has emerged as one of the most important technologies of the twenty-first century in recent years. Now that we can link common objects to the internet via embedded devices, including as kitchen appliances, vehicles, thermostats, and baby monitors, seamless communication between people, processes, and things is conceivable.

Physical things can exchange and gather data with minimum human interaction thanks to low-cost computers, the cloud, big data, analytics, and mobile technologies. Digital systems can record, monitor, and alter each interaction between linked items in today's hyperconnected environment. The physical and digital worlds collide, yet they work together.

Now that we know what these technologies are let's see why they are helpful in automobile industry.

- Uses of IoT in Automobile industry

In the enormous automobile sector, the Internet of Things enables for safe interactions between vehicles and their infrastructural components. This technology contributes significantly to increasing road safety, decreasing pollution, alleviating traffic congestion, and conserving energy through better fleet management. Emerging corporations and startups have created improved sensing technology to collect vehicle data. It also allows the automobile to grasp and understand its environment. The most appealing aspect of Enterprise Mobility App Development is that it automates toll and fuel payments.

The data obtained through IoT may be used to provide excellent value-added services to drivers via in-car apps. Real-time driving data may be used to provide information in navigation apps that informs drivers to potential dangers such as traffic hazards, poor road conditions, and so on.

Automakers, on the other hand, must handle and manage in-car software assets in a reasonable and logical manner, which includes thorough testing, correct software distribution, and tracking the deployment to retain a record.

Example of this includes:

- EcoG: EcoG is based in the United States and Germany. It's a firm that provides an Internet of Things-based operating platform and system for EV charging. The startup provides manufacturers with a number of technologies that enable maintaining and expanding EV charging infrastructure quick, easy, and scalable. It also allows operators to integrate microservices and services into chargers, making the charging process more economical. Furthermore, the solution is compatible with any EV charger.
- KonnectShift: It is a Canadian firm that provides Internet of Things (IoT) solutions to improve and organize asset and fleet management. The starter works in conjunction with the Konnect-GSO1 automated electronic logging device (ELD) to track the vehicle's health in real time. The solution includes route design and development for advanced and cutting-edge analytics, as well as real-time dispatch to provide warnings about cars, fuel, driving, and maintenance, reducing downtime and enhancing driver management applications.
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The blockchain technology has made information more secure and difficult to alter, hack, or cheat. It alters the procedures of the company. It enables connectivity and shared mobility solutions such as urban transit, ride-hailing, and delivery to share vehicle data through a secure network. It's also employed in the verification process to boost back-office productivity and supply chain efficiency. The impact of blockchain on the car industry is expected to grow in the future.

Blockchains have a wide range of uses in the automobile sector. Sharing vehicle data to a secure network to allow connectivity and shared mobility solutions such as urban transit, ride-hailing, and delivery are just a few examples. Furthermore, blockchain finds use in validating the spare parts supply chain, guaranteeing that the raw materials or

components are acquired from reliable, safe, and legal sources.

BMW, GM, and Ford, among other well-known automobile manufacturers, have already placed significant investments on blockchain technology. Ford, for example, is working to improve air quality in Europe.

Vehicles are growing into much more than just vehicles of transportation. In the twenty-first century, cars are mobile data centers with embedded sensors and disruptive technologies that collect vehicle data. By delivering more secure, traceable transactions and improved access to and openness of information, blockchain has the potential to promote trust and collaboration among enterprises, customers, and even automobiles. It's no surprise that automakers are paying attention to blockchain and investing strategically in the technology. While blockchain has the ability to disrupt the status quo on its own, it has even more promise when integrated with the Internet of Things (IoT), artificial intelligence (AI), and big data.

Here are some examples of blockchain's application in the automobile industry:

Insurance: The blockchain might be used to completely verify and safeguard vehicle mileages, allowing drivers who don't drive often to have reduced insurance rates.

Carsharing: An original equipment manufacturer provides vehicles on a timeshare basis (OEM). Trips are logged on the blockchain, and transactions between owners, operators, and third-party service providers are resolved promptly using a single-source, usage-based payment system.

Payments: E-contracts are a valuable commodity that blockchain enables since they allow for direct, secure money transfers from a buyer to a seller without the use of a bank or other intermediaries.

Personal information: Driver information may be stored on the blockchain safely and securely, allowing a carsharing vehicle to be instantly personalized to a user's preferences, such as seat, mirror, temperature, and radio settings.

Fleet owners can track the position of all of their cars and staff using RFID tags and data stored in the blockchain. This might contribute to time and distance savings, especially in the package delivery business.

Traceability: In the supply chain, blockchain may be used to verify the source of materials used in the construction of a car, all the way down to the raw material as soon as it is recovered from the mine.

Vehicle Recalls and History: A car's VIN may be stored on the blockchain, which means that whenever a recall is issued, owners of the exact vehicles affected by the problem will be

alerted, saving manufacturers money and inconveniencing drivers.

Autonomous Cars: For autonomous vehicles to be safe, massive volumes of data must be processed, evaluated, and sent safely and quickly. The blockchain provides a safe and reliable method of doing so.

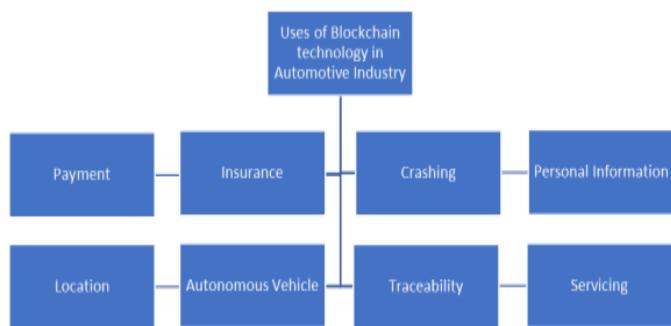
Servicing: A car's service history may be kept on the blockchain with a simple QR code scan, and the technology can be used to verify that only authentic OEM-supplied components are utilized for repairs or replacements.

Blockchain may give another means to optimize the benefits of self-driving, connected, and electric cars (EV) as the automobile industry works toward these technologies. Supply chain, financial services, and the safe, secure exchange of driver or passenger data appear to be the most ideal use cases.

There are still issues to sort out because to its immaturity, but with the degree of investment from across the industry, blockchain has the potential to cause significant upheaval. To win, you have to be in it, much like early Bitcoin investors, and we'll be waiting to see who goes all-in on the technology.

Example of this includes:

- **Cube Intelligence:** Cube Intelligence is a British firm that is working on a blockchain-based security platform for autonomous vehicles. Hash codes are used to prevent malicious attacks or hacking attempts on autonomous vehicles and connected vehicles. The device captures data on emissions and mobility in real time. In addition, cube intelligence equips AVs with valet parking and ride-hailing services, as well as smart parking management systems.
- **DAV:** It is an Israeli firm that offers a blockchain-based decentralized autonomous vehicle platform. This platform allows Autonomous Vehicles to find other AVs, clients, and service providers in their immediate vicinity. Vehicle-to-vehicle (V2V) communication takes place on the blockchain via smart contracts or off-block using DAV protocols. This company, on the other hand, creates drone flight planning protocols, charging networks, and open mobility.



(Figure 2- Blockchain in Automotive industry, msrcosmos insight)

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(Figure 3- Cube intelligence blockchain token plan, Cubeint.io)

1.4 Future Technological Trends in Automotive Industry

To create creative solutions, the automotive industry has a fantastic confluence of tech and industrial sector disruptors. With the digitalization craze sweeping the globe, the automobile sector is gearing up for a major transformation in 2021. In the last decade, the industry has witnessed a lot of ups and downs. However, as more technology is adopted in many sectors, the car business is continually progressing, allowing industrialists to earn more money and end-users to discover more novel driving approaches.

Apart from the fact that they have four wheels and steering, most characteristics of current automobiles are nearly unrecognizable from the original goods. The incorporation of technical advancements makes automobiles safer and more user-friendly, as well as adding various features that increase their worth and use for car owners. Contemporary autos, like modern cell phones, are capable of much more than merely getting you from one place to another.

Automobiles may now successfully integrate autonomous driving and accident avoidance, among other features, thanks to the advancement of digital technology. So, let's look at some of the future technologies which is likely to drive the automobile industry to a better and sustainable future.

- Hydrogen Fuel cell technology for automobiles

Fuel cell electric vehicles are expected to make their official debut in 2022. While the technology has been around for a long time (the notion was originally demonstrated in the early 1800s), more strict emission control requirements were required to truly develop innovation in the industry. Using hydrogen as a fuel source might help achieve global environmental goals: fuel cell-powered electric vehicles charge faster, have a longer effective range, and only release water as a byproduct of their operation. Of course, the infrastructure to refuel these vehicles is still largely absent, but policymakers in the United Kingdom, the European Union, and throughout the world are making headway. Cars like the Toyota Mirai, which was one of the first commercial deployments of fuel cell technology in a mass-produced vehicle, are supposed to pave the way for this clean technology; we'll see if 2022 is the year it ultimately succeeds.

- Experimentation with Augmented reality and voice controlled virtual-assistant

Automobile manufacturers have been playing with the concept of putting Augmented Reality in their vehicles, suggesting that AR-based window displays might increase safety. In fact, many models set to be released in 2022 already include augmented reality (AR) features that show vital driving data and navigation information onto the windscreen. You may turn your windshield into a screen for showing information to the user using augmented reality. The HUD may display pertinent information such as current

weather, speed, gas mileage, RPM, and speed, among other things. Drivers can follow directions without taking their eyes off the road thanks to navigation technology that uses holographic symbols. Meanwhile, advances in technology like as NLP (Natural Language Processing) paired with AI enable the usage of voice-controlled virtual assistants in automobiles to conduct simple activities such as making phone calls, playing music, and adding driving instructions without taking their eyes off the road. Apart from conventional carmakers, technology firms such as Google and Apple (whose Android Auto and Car-play products are already in cars) are also introducing voice-activated technologies to automobiles.

- Electrification of automotive vehicles

Automobile owners may save one-third on transportation costs by using electric vehicles instead of conventional gasoline. Hybrid automobiles and cars that operate on alternative fuels are examples of technological advancements in the automobile industry. Due to rising gasoline prices, electric automobiles are getting a lot of traction all around the world. According to research, the number of electric charging platforms would significantly expand in the summer of 2020. Because to mass manufacture and outsourcing of parts, vehicles are more affordable and widely available than at any other period in history. The global population's per capita income is rising, while the cost of automobiles is falling, resulting in a significant increase in demand for automobiles across the world. The gases are a result of fossil fuel burning and are detrimental to all living things as well as the environment.

The car industry is betting on batteries for the future. In a worldwide race to profit from emission-free electric vehicles, government agencies, investors, and carmakers are pouring money into battery development. According to the Indian Brand Equity Foundation, EV sales in India, excluding E-rickshaws, increased by 20% in FY20, reaching 1.56 lakh units powered by two wheelers. The growing reliance on fossil fuels, as well as the environmental damage caused by their usage, has altered the automobile industry's viewpoint. Furthermore, it has placed a strong focus on electric cars (EVs).

According to statistics, autos account for 15% of carbon emissions, causing possibly permanent environmental harm and depleting fossil fuel sources. Electric automobiles use a better level of energy efficiency and lower fuel usage to overcome these issues. Even though electric vehicles have limits, their acceptance and implementation in the sector is still controversial. Electric car manufacturers should provide solutions for issues such as battery life, affordability, charging infrastructure, renewable energy charging, and fleet electrification.

With human-caused climate change having negative consequences for the environment, every business is shifting

to more environmentally friendly technologies. The use of fossil fuels contributes significantly to environmental degradation, and governments all over the world are enacting tough emission standards. Emissions may be reduced dramatically by changing your lifestyle and how you use your cars.

- 3D printing integration with manufacturing process

With the rising demand for new cars and replacement parts in the auto industry, manufacturers and end users are always striving for newer, better performing vehicles, necessitating the optimization of production and the streamlining of supply chains and logistics. All of these objectives and problems are being met thanks to 3D technology. It's been looked into in every aspect of the automobile industry. It's utilized for more than just quick prototyping; it's also used to make tools and end parts.

The use of 3D printing to produce production components is already commonplace in the automobile sector, which is second only to aerospace and military in its utilization of additive manufacturing (AM). In today's cars, a wide range of AM manufactured parts are included into the total assembly. Engine components, gears, gearboxes, brake components, headlights, body kits, bumpers, fuel tanks, grills, and fenders, as well as frame construction, are all included. Some automakers are even printing whole bodywork for little electric vehicles.

AM will be especially important in terms of weight reduction for the developing EV industry. While this has always been desired for classic internal combustion engine (ICE) cars in order to improve fuel economy, it is now more crucial than ever because lower weight may result in significantly longer battery life between charges. Furthermore, battery weight is a disadvantage with EVs, with batteries adding over a thousand pounds to a midsized EV. Automotive components may be developed expressly for AM fabrication so that they are substantially lighter and have a far better weight-to-strength ratio. Rather than using metals, almost every item in every type of vehicle may now be made lighter via AM manufacturing.

Every year, the automobile industry experiences a boom in demand for breakthrough technology. Industrialists and researchers are developing cutting-edge manufacturing methods to suit these needs. Car manufacturers all around the globe are employing numerous approaches in order to provide end consumers with the best and most creative technologies. The auto industry will be greeted in the next years by a slew of new technological advances that will transform the landscape of the industry throughout the world.

Furthermore, additional collaborations/partnerships and acquisitions are predicted in the future across the automobile sector, with OEMs involving technology providers and other value chain organizations to stay

competitive. This is mostly to prevent new players/entities from gaining an advantage early on. With driverless automobiles, improved infotainment systems, and driver risk assessment, AI is changing the mobility sector. Traditional automakers must consider how to increase their revenue share in the future car industry. At the moment, technology corporations are leading the charge, utilizing their AI expertise (from established industries such as ICT) to seize the autonomous vehicle market.

3. CONCLUSIONS

The automobile industry is approaching a new age, with the need to transition to an altogether new product based on a complete shift in mobility propulsion. Because of the evident need to cut carbon emissions and counteract global warming, the transition from ICE to EV cars is being enforced. To tackle the challenge of designing and manufacturing the next generation of electric vehicles, the automotive industry is adopting developing AI and AM science and technology, as well as the application of the digital twin. Other sectors might benefit from following the car industry's lead in employing technology and science to bring their businesses into the twenty-first century.

There are still issues to sort out because to its immaturity, but with the degree of investment from across the industry, technology like blockchain has the potential to cause significant upheaval. To win, you have to be in it, much like early Bitcoin investors, and we'll be waiting to see who goes all-in on the technology. Blockchain technology may give another means to optimize the benefits of self-driving, connected, and electric cars (EV) as the automobile industry works toward these technologies. Supply chain, financial services, and the safe, secure exchange of driver or passenger data appear to be the most ideal use cases. Moreover, if we talk about technological integration in automobile industry, we can easily conclude that the industry is particularly obstructed by various advanced technologies that will also build and reform the industry's future.

Additionally, AI-based automated inspections, big data to impact design and manufacturing, and human-machine interfaces are all helping automakers redefine their processes. Machine intelligence and the Internet of Things, two new or future developments in the car industry, are boosting demand for electrified and self-driving automobiles. It's also potential to create new business models in shared car ownership, analytics-driven maintenance, safety enhancements, and insurance. Additionally, startups and developing enterprises develop technology that enable automobiles to safely communicate and trade over the internet.

Every year, the automobile sector sees a surge in demand for groundbreaking innovations. To meet these needs, industrialists and academics are creating cutting-edge

production processes. Automobile manufacturers all around the world are using a variety of strategies to give end consumers with the most innovative and cutting-edge technologies.

A wave of new technical developments will welcome the car industry in the next years, transforming the sector's environment throughout the world.

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