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Artificial Intelligence in Automobile

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Abstract
The integration of artificial intelligence (AI) in the automotive industry is revolutionizing various facets of vehicle design, manufacturing, and operation. This paper explores the key areas where AI plays a pivotal role, focusing on autonomous driving, advanced driver assistance systems (ADAS), predictive maintenance, and in-vehicle AI systems. Autonomous driving technologies leverage AI for perception, decision-making, and control, pushing the boundaries toward full vehicle autonomy. ADAS features such as lane-keeping assistance, adaptive cruise control, and emergency braking enhance driver safety by using real-time AI analysis. Furthermore, predictive maintenance systems utilize AI to forecast vehicle component failures, reducing operational downtime and extending vehicle lifespans. In manufacturing, AI improves quality control and supply chain efficiency, while in-vehicle AI systems offer personalized user experiences through voice recognition and augmented reality interfaces. Lastly, AI's role in smart traffic systems and the sustainability of electric vehicles (EVs) is discussed, highlighting its impact on energy efficiency and traffic optimization. This paper emphasizes how AI-driven advancements are transforming the automotive sector, enhancing safety, efficiency, and sustainability**.**

Keywords: Artificial Intelligence, Autonomous Driving, Predictive Maintenance, Smart traffic Systems, AI driven control Fusion.

1. Introduction

In today's era, the word artificial intelligence or AI, as it is addressed, is a technological revolution that is taking over all the domains in the world. Be it the software industry or the production industry, AI has advanced its root in every aspect. However, being such a common technology today, the real spirit of this technology is still an abstract to many, and it is important to first understand what artificial intelligence is. Although many definitions exist for this technology, the simple way to define artificial intelligence is as follows: Artificial intelligence (AI) is the intellect exhibited by machinery or software through the study and design of smart agents, where a smart agent is a system that observes its environment and takes actions that maximize its chances of success. Thus, when a mechanism mimics human-like behavior—for instance, learning, planning, cognitive reasoning, problem-solving, situational awareness, natural language processing, etc.—then it falls under the category of Artificial Intelligence. John McCarthy, who invented the term in 1955, describes it as "the science and engineering of constructing intelligent machines." Eric Schmidt, the executive chairman of Alphabet, the parent company of Google, states that AI could be leveraged to tackle major challenges, including climate change**,** disease diagnosis**,** drug discovery**,** macroeconomics**,** theorem proving, and protein folding. Mike

Schroepfer, chief technology officer of Facebook, expresses similar hopes that the power of AI technology can solve problems that scale to the entire world. Beginning in the 1950s, modern AI focused on what was termed strong AI, which referred to AI that could generally perform any intelligent task that a human could. The lack of progress in strong AI eventually led to what's called weak AI, or applying AI techniques to narrower problems. Until the 1980s, AI research was divided between these two models. However, around 1980, machinelearning became a prominent area of research, with its goal being to give computers the ability to learn and build models autonomously.

2. Literature Review

Even still, we are counting on Artificial Intelligence as the subsequent tool to transform the way we live, work, and interact with each other, which will be primarily enabled by machine learning methods. However, it remains unclear how these intelligent agents will help to solve more complex problems than those currently being addressed, considering that the state of the art in AI today focuses on tasks such as perceptively recognizing images and dynamically playing games.If we also look at the present status quo and examine who is driving the waves of progress in Artificial Intelligence, it becomes evident that major initiatives like Google**,** IBM**,** Microsoft, and Facebook are the key players in the field. The development in AI is also bringing stable consequences, such as job elimination through work automation. One such instance can be understood within the Industr**y** 4.0 framework, currently applied in the automobile industry. Industry 4.0 introduces what has been termed a 'smart factory,' where a large number of robots advance the entire manufacturing process with the help of cyber-physical systems**,** IoT, and cloud computing.The current state of the art in AI research makes it more capable in certain domains than humans; however, this is part of narrow artificial intelligence, which focuses on a limited range of problems—such as iPhone Siri. In 2015, several milestones in AI research and development gave rise to the concept of Artificial General Intelligence (AGI)**,** and this broader understanding of AI can be applied to various types of problems.In cognitive science**,** intelligence is defined in many ways, including one's capacity for cognition, logic, understanding, planning, problem-solving, self-awareness, and emotional awareness. A human-level intelligent machine should be capable of passing several tests; one of these is the Turing Test. However, there is no perfect test that can prove a machine to be fully human-level intelligent. If we look at the present state of AI, the pace of artificial intelligence evolution is accelerating. The NIPS (Neural Information Processing Systems**)** conference is one of the most renowned conferences in the field of Machine Learning and computational neuroscience**.**

3. Need of Artificial Intelligence

Early in the 1950s, present AI focused on what was termed strong AI, which referred to AI that could generally perform any intellectual task that a human could. The absence of progress in robust AI ultimately led to what's known as weak AI, or applying AI methods to narrower problems. Until the 1980s, AI research was divided between these two paradigms. However, around 1980, machine learning became a prominent area of research, with the goal of giving computers the ability to learn and build models so they could perform tasks such as prediction within specific domains.Research prior to 1950 introduced the idea that the brain consisted of an electrical network of pulses that fired and somehow orchestrated thought and consciousness**.** Alan Turing demonstrated that any computation could be implemented digitally. The idea that building a machine to mimic the human brain couldn't be far off

began to take shape. Much of the early research focused on this strong aspect of AI, but this period also introduced the foundational concepts that form the basis for all machine learning and deep learning technologies today.Although search algorithms can successfully be applied to many simple problems, this approach quickly fails as the number of possible choices increases. For example, consider the simple game of tic-tac-toe. At the start of the game, there are nine possible moves. Each move results in eight possible countermoves, and this continues. The full hierarchy of moves for tic-tac-toe (optimized to remove duplicates from rotation) consists of 362,880 nodes. If this same search approach is extended to more complex games like chess or Go, it quickly reveals the limitations of traditional search-based methods.

4. Problems with Modern Automobiles

A) Vehicle Accidents

Tens of millions of people have lost their lives or have become disabled worldwide in the last 10 years due to vehicle accidents. Almost all traffic accidents are caused by human errors. Unfortunately, according to statistics, the number of lives lost each year is likely to double in the next 10 years. According to the World Health Organization (WHO), road transportation injuries caused an estimated 1.26 million deaths worldwide in the year 2000 (Source: World Health Organization, 2000). Globally, it was estimated in 2004 that 2.5 million people were killed in transportation accidents, accounting for 4.7% of all deaths (World Report on Road Traffic Injury Prevention, WHO, 2004).

B) Grand Theft Auto

The term is associated with the stealing of automobiles. This is a major security concern in the entire automobile industry, where hundreds of vehicles are stolen every year without a trace. Property losses due to motor vehicle theft in 2013 were estimated at $4.3 billion in the United States alone, according to the Wall Street Journal. In India, as per the Ministry of Transportation, the number of vehicles stolen was approximately 135,431 in 2013.

C) Driver Distractions

The safety factor while driving an automobile is something that cannot be overlooked. It is one of the key features that can either cause or prevent a catastrophe. Even though all standard and elite- class automobiles are equipped with the latest technologies to increase driving safety, statistics tell a different story. According to the "Accident Attorney" website, the major forms of distraction include texting, talking to a passenger, loud music, and alcohol consumption. More concerning is the fact that the majority of these accidents are caused by teenagers.

D) Maintenance Scheduling

Maintenance of automobiles is an essential and necessary task for every vehicle owner. A well-planned maintenance schedule results in better efficiency and performance of the vehicle. However, regular or scheduled maintenance is often not followed by the owner, leading to a decline in the vehicle's performance. Another issue arises when the owner is unsure of when to schedule a maintenance run. This can result in unnecessary servicing, which is neither beneficial for the vehicle nor cost-effective for the owner.

E) Miscellaneous Issues

There are several issues that are not being adequately addressed by modern automobiles. Although research is ongoing in all major automobile industries, it may take another five to six years for these technologies to become commercially available. Until then, we must consider that these technologies still do not exist.

Some of these issues include the need for an automatic speed control device that allows users to set a predefined speed limit. Additionally, there is currently no technology capable of performing an automatic diagnosis of the vehicle, indicating which parts require replacement.Other, seemingly minor issues can lead to significant disasters on the road. For example, a faulty mechanical component in any part of the system can wreak havoc on the entire vehicle. Adverse weather conditions can also sometimes lead to unexpected tragedies that could be avoided with proper precautions.Furthermore, the condition of some vehicles is so poor that driving them poses an inherent risk. Inexperienced drivers who lack prior experience may find themselves in critical situations. So far, no technology or vehicle engineering solution has been commercialized to assist such drivers.Illegal driving is another contributing factor. Drivers below the legal age are often seen on the roads, and the only way to apprehend these individuals is through law enforcement, which can sometimes be too late in many instances.

5. Solutions with Artificial Intelligence

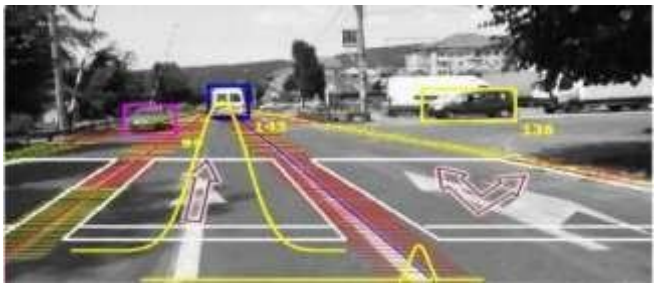
Artificial intelligence is revolutionizing automobile manufacturing, with all major automobile companies leveraging their resources and expertise to develop cutting-edge technologies. When intelligence is applied to the data within an automobile, it can assess the environment and make appropriate recommendations when encountering traffic or obstacles. In 2015, the connection rate of AI- based systems in new vehicles was just 8%; this figure is expected to soar to 109% by 2025. This increase is attributed to the integration of various types of AI systems into vehicles.

A) Driverless Car

The concept of driverless cars has been around since the 1970**s**, so it is not entirely new. AI-powered cars, depicted in various forms over the years, have long captured our imagination. However, the lack of technical expertise and resources likely prevented this concept from becoming a reality until recently. Now, with advancements in artificial intelligence, driverless cars are finally becoming a tangible possibility. It is merely a matter of time before we begin to see real intelligence in them. The goal is to enable the vehicle to operate like a human driver and navigate through various conditions. While this may sound straightforward, it is anything but simple, as extensive calculations and algorithms are required. Through techniques such as sensor fusion and deep learning, researchers are developing technology that will create a three-dimensional map of all the activities happening around the car. Leading tech and automotive giants, such as Google and Tesla, are investing millions of dollars in research to improve this technology and make autonomous cars a commercial reality

B) Driver Assist Feature

Although relatively few corporations are focused on fully automated vehicles, a growing number of manufacturers are moving in that direction. By introducing features that assist the driver without taking over the wheel, many companies are adopting a cautious approach to AI-based technologies while still rolling out vehicles with advanced safety features.Automatic braking, collision avoidance systems, pedestrian and cyclist alerts, cross-traffic warnings, and adaptive cruise control are some of the essential features powered by AI. The willingness of automobile manufacturers to develop automated cars, delivery trucks, and other vehicles opens up a wealth of new opportunities. Corporations that can innovate and capitalize on this exciting new market will find ample investment prospects.



C) Cloud Hosted Intelligence

Cloud computing offers several advantages that make it the ideal platform for staging and deploying AI technology in the automotive industry. Key benefits include fast processing speed, access to big data and analytics, and centralized connectivity. As companies strive to develop cutting-edge automotive technology, cloud-based platforms will be essential in supporting these innovations.One notable

example of cloud utilization is the collaboration between General Motors and IBM's Watson supercomputer. An extension of GM's popular OnStar system, the platform being developed will incorporate AI-enhanced features, further enhancing the driving experience.

D) Internet of Things

As of 2020, manufacturing specialists estimate that nearly 250 million cars will be connected to the Internet. With new vehicles equipped with a multitude of smart sensors, built-in connectivity features, and enhanced geo-analytical capabilities, it makes sense to leverage an IoT (Internet of Things) connection effectively.

There are already several ways in which IoT technology is influencing, or will soon influence, the automotive industry. Insights will be drawn from vast amounts of unstructured data to enable vehicles to respond naturally in real time. Additionally, cognitive capabilities will be required to adapt to changing operational conditions. Car manufacturers have already begun integrating these technologies into their vehicles

E) Intelligent Risk Insurance Assessment

Insurance companies are continuously seeking ways to reduce risks, leading them to partner with automotive and technology firms to identify risky drivers. One such collaboration involves Nauto, a technology developer, BMW I Ventures, Toyota Research Institute, and the insurance company Allianz Group. Nauto has established agreements with these partners to develop AI-based products aimed at fleet management, logistics, and driver safety.

Using deep learning AI technology, Nauto is developing a cloud- based platform to track driver alertness, near misses, and unsafe driving habits. The goal is to create a connected car network that will include an ever-increasing number of connected vehicles. Nauto's AI platform and associated network will assist fleet companies in operating their vehicles more safely and efficiently. By monitoring driver behavior, the system will enable insurance companies to identify drivers prone to risky habits, leading to adjusted premiums based on the assessed risk.

6. Conclusion

We find ourselves at a pivotal moment in history, one where predicting the future of humanity in the context of Artificial Intelligence is increasingly challenging. While we have consistently embraced new technologies that promise to change our way of living, it is crucial to recognize that the pace of change we are experiencing must yield positive outcomes for the well-being of society and, ultimately, humanity as a whole.

Artificial intelligence represents a transformation that we should not take for granted. It differs from any other knowledge humans have ever developed, primarily due to its capacity for autonomous action. This unique attribute means that AI can begin to exert both positive and, potentially, harshly negative impacts on society almost immediately.

As we adopt AI as a force that is expected to redefine our lives, we must be prepared to confront the consequences, whether they pertain to employment, privacy, or the very essence of what it means to be human. In all scenarios, it is imperative that we establish a legal policy framework designed to mitigate the challenges associated with AI and ensure compensation for those affected in the event of catastrophic failures.

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