

The Application of Artificial Intelligence and 5G Technology in Automotive Industry

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Abstract: In the context of automotive energy innovation, with the advancement and application of artificial intelligence and 5G technology, new energy vehicles are developing at an extremely rapid rate. In the past year, many books on the application of mathematical modeling and artificial intelligence in the field of new energy vehicles have been published. According to research, artificial intelligence has played a great help in the intelligentization of new energy vehicles, such as intelligent batteries and driving parts. On the other hand, 5G technology provides a technical foundation for new energy vehicles in signal transmission and device interaction. As well as the analysis and prediction of the new energy vehicle market by mathematical models. The purpose of this article is to provide and summarize the application of artificial intelligence in the fields of automobile manufacturing, driverless driving, and driving route planning.

1. Introduction

With the continuous development of science and technology, automobiles have become more advanced, especially in the application of AI. The purpose of this article is to study and analyze the application of artificial intelligence and 5G technology in the automotive field in manufacturing, autonomous driving, and intelligent navigation. Artificial Intelligence contributes a lot to self-driving. Machine learning uses different apparatus based on AI to help autonomous cars to work safely and accurately. In addition, AI is also used in all steps of automobile manufacturing. At the same time, AI and 5G technology also play a huge role in route navigation, such as route planning, vehicle condition information and other aspects. We have integrated some articles on the market and technology of new energy vehicles and summarized them. We hope to provide help and support to researchers in this field.

The rest of the paper can be divided into the following sections. Sections 2 presents the application of artificial intelligence in automobile manufacturing. Section 3 shows the application of artificial intelligence in autonomous driving field. The history and AI technology used in smart city traffic navigation are provided in Section 4. Finally, the conclusion and future challenges are presented in Section 5.

2. The application of artificial intelligence in automobile manufacturing

Before listing several aspects of the contributions of AI in cars manufacturing, we firstly introduce the process of vehicles manufacturing and the concept and the effects of artificial intelligence. The typical car manufacturing process is divided into four steps. Coils rolls of steel and aluminum, are cut, pulled, bent, and punched in several steps during the first step. As a result, molded parts such as side frames, doors, hoods, and roofs are produced. This first step is typically highly automated, with up to 90% automation [1]. The assembly of several hundred different parts to a welded car body is the next

production step, known as body store or body-in-white. As a result, the highest degree of automation can be found, with more than 90% achieved primarily using robots [2]. The car bodies are then transported to the painting shop, where a multi-layer painting process of the interior and exterior is carried out. The paint shop is typically less automated than the body shop, but it can still be considered highly automated [3].

A readily painted car body goes to the assembly. In this step, the painted car bodies get complimented by all missing parts. Due to the high number of variants, this production step is characterized by a large complexity. Therefore, and in contrast to the previous steps, the degree of automation drops sharply and usually amounts to less than 20% [4].

2.1 The function and effects of AI in car manufacturing.

Artificial intelligence is a very broad concept in a nutshell. It is about human awareness and simulation of the thinking process, using machine learning and data analysis methods to empower machines like humans. Artificial intelligence will improve social labor productivity, especially in terms of effectively reducing labor costs, optimizing products and services, creating new markets and employment, etc. Generalized artificial intelligence refers to the effect produced by the realization of the human mind through the computer. The result is a description and description of an agent that can acquire perception and perform actions construction; relatively narrow artificial intelligence includes artificial intelligence industry (including technology, computing multi-faceted value systems such as law, application, etc.) and artificial intelligence technology (Including using machines to help, replacing or even partially surpassing humans to realize cognition, recognition, analysis, Decision-making and other functions). [5]

Aspects	Advantages and features
New patterns	Internet-based, collaborative, flexible, and socialized intelligent manufacturing system used to promote production.
New means	The Internet of Things, virtualization, customization, flexibility, and intelligence are all characteristics of a human-machine integrated intelligent manufacturing system.
New forms	Intelligent manufacturing ecology with universal connectivity, data drive, cross-border integration, autonomous intelligence, and mass innovation.

Table 1. Artificial intelligence achieves some changes, bringing several benefits of certain products and services for customers.

These models, means, and forms will be deeply integrated and eventually form an intelligent manufacturing ecosystem, as shown in Figure 1. [6]

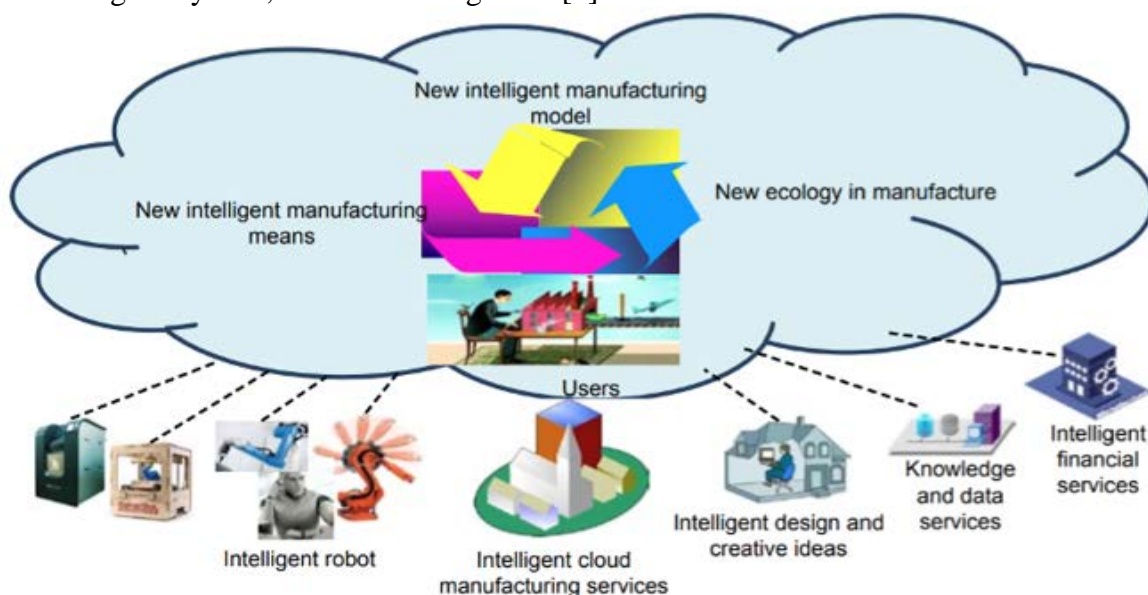


Figure 1. New models, means, and forms of intelligent manufacturing.
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2.2 AI contributes to in vehicles manufacturing

Artificial intelligence promotes the efficiency and the level of product design. Artificial intelligence technology empowers automobile R&D and enhances the level of automobile product design. From the standpoint of artificial intelligence technology application, the application of artificial intelligence in the field of automobile research and development is the most recent. Its fundamental technical logic is to use intelligent software to digitize the drawings and parts of automobile manufacturing, and artificial intelligence algorithms to analyze the automobile's components and materials. The manufacturing process is optimized to reduce production costs, improve automotive product functions, and test automotive product performance. Cloud computing, machine self-learning, and AR/VR Wait are the most common artificial intelligence technologies used [7] The first to apply artificial intelligence technology to car design were well-known car manufacturers such as BMW, Audi, and Porsche. The core goal is to achieve product performance improvement based on controlling product manufacturing costs.

2.2.1 Product quality inspection.

Intelligent quality inspection is the most mature application of artificial intelligence in the manufacturing field. Using image recognition and deep learning technology can solve the pain points of traditional quality inspection such as high labor cost, inability to run continuously for a long time, only random detection, and low defect detection rate. Significantly improve product quality inspection efficiency and defect detection accuracy, while reducing labor costs to ensure the qualified rate of shipped products. The intelligent quality inspection system can inspect the products and finished products one by one, and accurately distinguish various defects of various materials such as metal, synthetic resin, and plastic. Auto parts production workshops, auto stamping, welding, painting, and assembly workshops can use machine vision recognition to quickly scan product quality and improve quality inspection efficiency. In addition, because these systems can continuously learn, their performance will continue to improve over time. At present, some auto parts manufacturers have begun to use vision systems with machine learning algorithms to identify parts with quality problems, including detecting defects that did not appear in the data set used to train the algorithm. AI vision technology company Poseidon can detect the appearance of automotive electroplated parts with an accuracy of 0.1mm; Aqiu Technology uses artificial intelligence and 3D vision technology to perform industrial quality inspection and sorting. [8]

Artificial intelligence highly contributes to vehicle manufacturing. And, with more research about the future development of cars, artificial intelligence will replace the responsibilities of humans, operating the process to invent and produce cars. Artificial intelligence will be more and more important in cars manufacturing, to develop the function of cars, ensure the high efficiency and high quality with lower cost. The purpose of this article is to provide and summarize the application of artificial intelligence in the fields of automobile manufacturing, driverless driving, and driving route planning.

3. The application of artificial intelligence in autonomous driving field

Artificial intelligence helps people to use a computer to identify several important aspects. The various AI techniques used are fuzzy logic and Artificial Neural Network, containing many passive and active sensors [9]. Autonomous cars are becoming more and more prevalent. Tesla autopilot has a very deep effect on the design of autonomous cars. Artificial intelligence covers all aspects of autonomous cars. From collecting information to identifying potential threats, AI helps autonomous cars to better detect the lanes and make better choices. The components of each apparatus form the autonomous cars and help them to work efficiently and safely. From now, many car companies that have taken the step from Tesla are getting involved in the autonomous car industry [10].

3.1 Machine Learning in Autonomous Cars.

Machine Learning in Autonomous Cars has become an important field for computer systems to learn how to make decisions and detection. Also, it helps autonomous cars to understand and interpret ideas from researchers. Hofmann, Neukart, and Bäck (2017) studied about machine learning for two kinds of machine learning, one is supervised learning algorithms, and another is unsupervised learning algorithms. For the first one, it is used to detect variables in different circumstances, then make decisions based on the data. And another is to identify the relationship and make decisions automatically. Based on this AI, people have already invented a kind of vehicle known as an autopilot, driverless car, auto-drive car, or automated guided vehicle.

3.2 The applications of Artificial Intelligence in Autonomous Cars

Autonomous vehicles make use of deep learning and artificial intelligence to make informed decisions and detect the surrounding environment, just like a human being. Autopilot came from Tesla, which claims that it will provide more opportunity and safety for drivers. So artificial intelligence made huge progress in this development, which allows vehicles to use data from the surrounding cameras, radar, and ultrasonic sensors.

Camera system can view various objects such as cars, trailers, bikes, cyclists, pedestrians, and road markings. And the chip of Mobileye Eye gets the tiny silicon which facilitates other equipment in the autopilot system. Furthermore, the ultrasonic sensors, which are spread out on the car's corners: the front-side and rear sensor (aperture 75 deg.) and the passive rear-side sensor (aperture 50 deg.), which can be used to receive emitted echo.

A satellite-based road monitoring system consists of three components: an in-car unit, a central computer server, and a mobile satellite communication system. The car is then kept in its current lane by AutoSteer, which activates Traffic-Aware cruise control to maintain the vehicle's speed. Auto Steer assists the driver on the road, making it easier to drive. When AutoLane Change is enabled, changing lanes is simple. The autosteer will help the car find the adjacent roads with safe speed to pass through.

Automatic emergency steering and side collision warning further improve the active safety capabilities of autonomous cars by sensing range and helping detect potential threats. Researchers can use this kind of equipment to lower the potential threats in the road. While unassisted drivers avoided the collision as well, assisted drivers established a lateral safety distance more frequently and earlier. In this case, autonomous cars become more and more safe. [11].

4. Smart city traffic navigation

4.1 The history of car navigation.

Transportation is a very critical part of the historical process of the development of human civilization, and the degree of development of transportation often represents the development level of a region. With more and more developed traffic routes, the role of vehicle navigation in people's lives has become more and more important. French [12] described in detail the development and evolution of navigation from ancient China to modern society in more than 2,000 years. From the original magnetic compass used by ancient Chinese people to use the bright stars at night to navigate themselves, then people began to use gyroscope equipment, and finally to now use satellite positioning. On the other hand, the focus is to focus on the car's navigation system and gradually develop into a global traffic intelligence system. At this point, we will notice that since the information revolution, the development speed of traffic navigation has been greatly improved, and AI technology is the key.

4.2 Analysis of the advantages of artificial intelligence in navigation.

AI, artificial intelligence, has been integrated into every corner of our lives, and it exists in our education, medical and other fields. Especially in traffic navigation systems. In another paper, Krisp

[13] described how to use AI to calculate, predict, and avoid complex and congested intersections; and AI brings more than just ordinary navigation, it can provide drivers with personalized navigation services, for example, through calculation and comparison, coupled with the driver's driving preferences to navigate. This is the gospel of many novice drivers because AI can provide “humane” navigation services instead of cold and blunt traditional navigation, for example, in Figure 2, AI will help us filter out suitable intersections and itinerary.

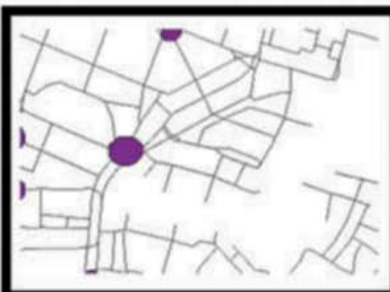

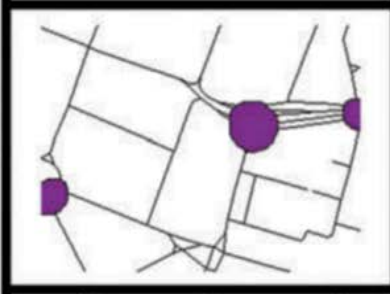

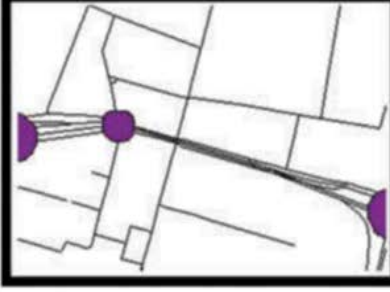

	Map view: obstacle polygon	Street view	Description of the crossing
(1)			- complicated left turns Amount of counted road element nodes: 97 Search radius: 60 m Cell size for KDE: 5 m
(2)			Amount of counted road element nodes: 67 Search radius: 60 m Cell size for KDE: 5 m
(3)			Amount of counted road element nodes: 33 Search radius: 60 m Cell size for KDE: 5 m

Figure 2. Selected obstacle polygons on the road network (1. to 3.).

AI will automatically pre-calculate the number of unit nodes in the route (the complexity of the route) to provide drivers with a more convenient and efficient route. Reproduced with permission. 13 Copyright 2015, Taylor & Francis.

In recent years, the topic of smart cities has been repeatedly mentioned by people. In this context, a set of urban intelligent traffic navigation systems built based on AI calculations has been implemented in Singapore. X Ai-gong [14] talked about a set of digital model road map databases built by GPS/DR to continuously locate vehicles in Singapore and provide voice or text navigation services to drivers through AI, as shown in Figure 3 and 4. On the other hand, the location information of the vehicles will also be uploaded to the control center to facilitate better management of the vehicles in the city. The implementation of Singapore's intelligent transportation system is a big step in the development of AI in the global navigation system, which proves the feasibility of the system.



Figure 3. Route plan 1 to the destination.
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Figure 4. Route plan 2 to the destination.
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4.3 The self-learning ability of AI technology, and the cooperation with other equipment and technology.

Compared with other technologies, another huge advantage of AI technology is that its development space is huge. Because AI is difficult to reach the bottleneck, it can “learn and improve” by itself. First, AI can develop with the development of related technologies, such as 5G technology. The arrival of 5G has brought great convenience to people’s lives. This is not only reflected in the fact that the speed

of downloading movies on your mobile phone has become faster. It has a more significant significance in that it greatly improves the information exchange between devices. Speed, which will also assist the role of AI. Rezgu [15] proposed a platform that can provide interactive information between cars to improve the efficiency and safety of traffic. The role of 5G technology is reflected here, it can help the transmission of information between cars faster and more efficiently. On the other hand, 4 also mentioned the self-learning ability of smart vehicles, which enables the navigation system to analyze and learn and improve itself when receiving information from other vehicles or facilities. Not only that, but we can also make AI more perfect by putting “eyes” on AI. Do T D [16] proposed that by adding a camera and a deep analog neural network to the autopilot navigation system of the car, real-time navigation and even driving of the vehicle can be achieved? At the same time, this is also the theoretical basis of the autopilot function of the car. In the text, Convolutional Neural Network (CNN) is said to be used as the “eyes” of the vehicle, because it can not only provide the role of the eyes of the AI navigation system, but also perform a lot of analysis and study millions of Data model, at the same time, it has the same advantages as AI functions.

5. Conclusion

In the field of new energy vehicles, artificial intelligence technology and automation will largely improve the competitiveness of new energy vehicles. On the other hand, 5G technology will also create huge advantages for information interaction of new energy vehicles. According to the mathematical model to understand the market scale development of new energy vehicles, we can analyze the speed of the development of new energy vehicles extremely fast, and there is still a lot of space for development. On the other hand, continuous technological breakthroughs have brought infinite possibilities to the new energy vehicle market.

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