Advanced Applications of AI Technology in Automated Vehicles

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Abstract. Currently, driverless and artificial Intelligence (AI) technologies are both developing rapidly, and the combination of the two could be instrumental in the development of driverless cars while having great commercial value. Current research on AI focuses mainly on algorithms, and there is still less integration with actual machinery and facilities. The application of AI to drones is promising, but the technology for the public is still at a low level. This paper summarizes the existing applications of AI in unmanned vehicles and analyses the problems of AI when algorithmic development reaches its limits. Finally, it gives a method to promote the combination of the two technologies. This paper summarizes the existing applications of AI in unmanned vehicles by suggesting that AI has a wide range of applications in unmanned vehicles. In further development, in addition to the improvement of technology, it is also very important for the popularization of the technology. This research can give a boost to the future development of AI applications in drones.

Keywords: AI, Automated vehicles, Automotive sector

1   Introduction

AI is a tool that simulates, develops, and extends human intelligence. Furthermore, AI as a branch of Computer Science, is designed to make decisions in a manner like human intelligence [1].

At present, AI is driving the development of many industries. Compared with the human brain AI handles data more quickly and accurately [2]. AI can help with data collection and aggregation, combining knowledge with practical operations, which can help with scientific research [2]. As a result, in the engineering aspect, AI has become a significant tool.

Driverless vehicles are vehicles that can operate autonomously under unmanned conditions. A driverless vehicle needs to recognize the surroundings without human intervention and use the results to manipulate the car's systems [3]. Therefore, AI as a tool that can perform as humans is suitable for the aspect of Autonomous vehicles because it can simulate humans, to drive and deal with the problems encountered in driving more quickly and accurately.

At present, the use of AI technology in driverless vehicles is not comprehensive enough. It is mainly used in the commercial sector for things like smart cockpits, and fully autonomous driving systems are not yet widespread. Besides, the relevant regulations and the division of responsibility are not clear.

This paper overviews the application of AI in unmanned driving nowadays, summarizes the problems involved, and gives appropriate suggestions. This paper focuses not only on the application of technological aspects but also on the changes in the human mind and the role of aspects in promoting the development of unmanned technology.

2   Technical Overview

2.1   A Brief Summary of the Developments of AI

In the past few years, AI entered many areas of people's lives. Such as face recognition, and accurate pushing of big data, these technologies have already been largely used [4].

However, the development of AI has reached a bottleneck. The development of arithmetic such as deep learning has reached an elevated level. The next step of the development of AI should focus on the interaction between AI and machines, people, and environments [4].

As a result, the development of realms such as driverless cars have received attention, because now these realms still have great potential for growth.

2.2   A Brief Summary of Autonomous Vehicle Developments

At current, the existing autonomous vehicle level of advanced driver-assisted system (ADAS) is classified into six levels. At Level 0, Drivers driving themselves. At Level 1, ADAS helps conduct some basic operations such as acceleration and brake. At Level 2, the ADAS takes all basic actions, but the drivers need to monitor the surroundings of driving. At Level 3, the Advanced Driving System (ADS) takes all actions in driving, but if it requests the driver needs to take control of the vehicle again. At Level 4, human drivers are unnecessary, but the vehicles should run in a limited environment. At Level 5, ADS takes over the driving completely and is not limited by the environment [2].

At present many car companies have reached level 3 and level 4 which means the development of driverless vehicles has been rapid in the last few years.

3   Application of AI Technology in Automated Vehicles

3.1   Status of AI Technology Used in Automated Vehicles Applications on Sensors.

At present, automated vehicles depend mainly on sensors for their perception of the outside environment [5]. There are three main types of sensors installed in driverless cars today.

The first is a radar sensor It is mainly used for the identification and detection of obstacles when the car is travelling, such as pedestrians, cycles, and so on. There are three main types of radar currently in use. Among these radars, laser radar is the most accurate, but the price cost is high. Such as the automated vehicles designed by Google, the cost of laser radar reached almost $700,000 [5]. Compared to laser radar, millimeter-wave radar (MWR) has a lower price, can detect greater distances, and get more information about the surroundings, so, it is already widely used in automated vehicles. The last type is ultrasonic which has the lowest price, but the accuracy is also low and only be used in detecting the collision of the vehicles.

The second is vision sensors. This type of sensor, they are not only used in detecting the obstacles on the roads. Vision sensors are mainly used to detect the signals on the roads. In this way, ADS can reach a higher level.

The last is the position sensor. Position sensors not only can provide position information but also information about travel angle and travel speed. At present, to obtain information such as latitude and longitude coordinates and velocity, China mainly uses RTK GPS technology. However, this system is easily influenced by the high buildings [6]. So, good infrastructure is an important aspect of the development of automated vehicles.

Applications in Decision-making. The decision-making of a human being while driving is based on the accumulation of experience, which can help the human being deal with unexpected situations while driving. However, the human ability to deal with accidents is restricted, so, traffic accidents will happen due to human error.

At present, automated vehicles' ability in decision-making is based on deep learning.

Deep learning comes from a neural network system, it not only can process large amounts of data, but also can use big data deep learning to enhance the autonomous driving system's own driving capabilities [6]. After a prolonged period of training, the AI becomes an experienced driver. The difference between a human driver and an AI is that its perception of the driving environment comes from its various sensors.

As shown in Fig. 1, the steps in applying deep learning to drones can be broadly categorized into five steps:

(1). Collect necessary data.

(2). Preprocess the data and select data with bandwidth for training to reduce computational pressure.

(3). A convolutional neural network is used to process the preprocessed data and classify the approximated data.

(4). Improve accuracy of judgment by controlling learning computations through supervised learning systems.

(5). To ensure the accuracy of the data, further adjustments are made to the data at all stages of the deep learning system [7].
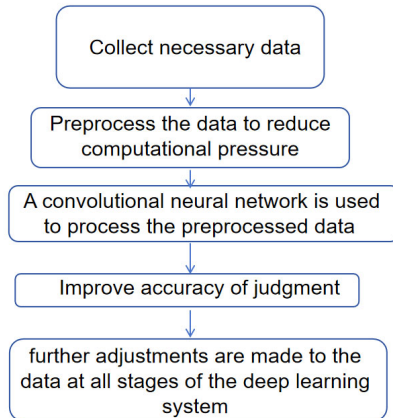

Fig. 1. The simplified process of deep learning. (Photo/Picture credit: Original)

Applications on Route Planning. Autonomous Vehicle technology can help drivers rationally plan their journeys through the ability of algorithms to process enormous amounts of data, saving considerable time costs and reducing fuel wastage.

Nowadays in path planning, information sharing systems are in widespread use. Information-sharing systems can help autonomous vehicles share information about their location and the situation on the road with other autonomous vehicles. As a result, autonomous vehicles can maximize time and cost savings by adjusting their route planning in real-time and choosing the fastest and safest route. This system can also help adapt vehicles to give way, to allow ambulances to cut through.

However, autonomous vehicles collect a large amount of useless information while travelling. Therefore, if the information is not processed and analyzed in a timely enough manner, it is difficult for the information-sharing system to achieve the desired effect. Even, new congested roads will be generated.

Human-Computer Interaction. Today's Autonomous Vehicle still cannot completely replace the driver. So human-computer interaction remains important. At the same time, intelligent human-computer interaction can also improve the driver's driving feeling. At present. There are totally two diverse ways of Intelligent Interaction currently [8]. The Autonomous Vehicles Intelligent cab system, as shown in Fig. 2 [9].

Intelligent voice: Intelligent voice allows passengers to communicate flexibly with the intelligent driving system. Therefore, intelligent voice is more convenient and quicker to meet the various needs of passengers, such as opening maps, changing routes, and small functions such as the current temperature. It can enhance the passenger's riding experience.

Intelligent systems can record user preferences for flexible route planning. For example, if there are multiple destinations, routes can be planned that are closer to the passenger's preferences.

Fig. 2. The Autonomous Vehicles Intelligent cab system [9].

4   Existing Issues and Suggestions

4.1   Network Security Issues

Network security is a severe problem in the development of the connection between AI and AV. AI technologies require networks when combined with drones, especially in the delivery of information. For example, the information-sharing system mentioned above requires a prominent level of cybersecurity, and if the system is hacked, it could cause serious traffic problems.

For this reason, the development of security systems, such as firewalls, should be enhanced in the development of AI systems. Also, for developers of commercial systems, agreements. should be signed to prevent developers from exploiting system vulnerabilities. Finally, AI systems should also be timely.

4.2   Ethical and Legal Issues

As driverless technology continues to develop, the issue of liability and insurance is becoming increasingly important [10]. One of the major questions is how to allocate responsibility if an autonomous vehicle engages in an accident [11]. The owner of the car or the car company should be responsible for the accident. Whether the responsible company is the one that provides the AI control system or the one that manufactures the driverless car is also a key question. Determining responsibility is even more complicated, and laws need to be formulated as a matter of urgency.

In addition to the timely enactment of relevant legislation, it is also crucial to shape people's minds. Getting people to accept driverless cars and AI can also promote the development of related technologies.

5   Conclusion

This paper summarizes AI applications in driverless cars. Four aspects of the application of AI to driverless cars are the application of sensors, decision-making, routine plane, and human-computer interaction. These four aspects show that AI has already been used in automated vehicles a lot. Based on these four aspects, this paper systematically summarizes the application of AI sensors in unmanned driving, reveals the design mechanism of three kinds of sensors and their application value in intelligent value, analyses the technical routes of path planning, and elucidates the existing solutions to the challenges and technological difficulties in the practical application of AI in unmanned driving. However, there are still existing problems about the use of AI and problems include Network security-- and Ethical and legal issues. Then, this paper gives rational suggestions for the existing problems and a summary of the use of AI in AV. In the future, AI can be used more in AV, and it may replace human drivers with the development of the technology.

References

1. Xiao, L., Xian, Z., Ke, Z., Zhen, D., Kai, Z. and Xi, W.: Study on the Application Fields and Development Prospects of AI, 2021 2nd International Conference on AI and Education (ICAIE), pp. 101-105, Dali, China, (2021)
2. Xiao, L.: Application and research of AI in mechatronic engineering, 2020 5th International Conference on Mechanical, Control and Computer Engineering (ICMCCE), pp. 235-238, Harbin, China, (2020)
3. Balasundaram, A., Prusty, M. R., and Shaik, A.: A Comprehensive Study on the Impact of AI in Autonomous Vehicles, 2022 International Virtual Conference on Power Engineering Computing and Control: Developments in Electric Vehicles and Energy Sector for Sustainable Future (PECCON), pp. 1-5, Chennai, India, (2022)
4. Liu, W., Zhuang, G., Liu, X., Hu, S., He, R., and Wang, Y.: How do we move towards true AI, 2021 IEEE 23rd Int Conf on High Performance Computing & Communications; 7th Int Conf on Data Science & Systems; 19th Int Conf on Smart City; 7th Int Conf on Dependability in Sensor, Cloud & Big Data Systems & Application (HPCC/DSS/SmartCity/DependSys), pp. 2156-215, Haikou, Hainan, China, (2021)
5. Chen, J., Zhu, P.: Discussion on the application of AI technology in the field of driverless cars. Auto and Driving Maintenance (Maintenance Edition), 71-72 (2019)
6. Hu. Y, Application of AI technology in the field of unmanned driving. Henan Science and Technology, 27-29 (2020)
7. Guo, C., Chen, S., Sima, H.: Analysis of the application of AI technology in unmanned vehicle. Times Automotive, 190-192 (2023)
8. Chen, J. Application of AI Technology in the Field of Driverless Cars. Automotive Test Report, **10**, 37-39 (2023):

9. Wang. C, Zhai. H. Application of AI technology in driverless cars. Information and Computer (Theoretical Edition), **10**, 211-213 (2023)

10. Shen. Y, Zheng. R. Design of Compulsory Insurance System for Driverless Cars in the Age of AI--An Appraisal of Attribution of Tort Liability for Driverless Accidents. Journal of Guangxi Police College, **5**, 42-52 (2021)

11. Huang, C., Zhang, Z., Mao, B., and Yao, X., An overview of AI ethics, IEEE Transactions on AI, **4**(4), 799-819 (2023)