

The Application of Artificial Intelligence in the Field of Transportation

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ABSTRACT: Urban traffic is the lifeblood of urban economic activities and plays a very important role in the development of the urban economy and the improvement of people's living standards. Although the automobile industry brings convenience, it also brings a heavy burden to urban traffic. The imbalance of urban traffic supply and demand has become a serious problem faced by major cities, especially in large cities, the phenomenon of traffic congestion. This not only affects the normal operation of the city, but also reduces the daily work efficiency of people. This paper is based on mature scientific principles and physical devices, such as dynamic Bayesian network, machine vision, machine learning, pattern recognition technology, temperature sensor, optical fiber sensor, etc. The application of artificial intelligence technology in highway traffic is discussed in detail, which lays a theoretical foundation for the development of intelligent traffic in the future.

1. INTRODUCTION

Artificial intelligence is a branch of computer science that attempts to understand the essence of intelligence and produce a new kind of intelligent machine that can respond in a similar way to human intelligence. Research in this field includes robotics, language recognition, image recognition, Natural language processing and expert systems, etc. Since the birth of artificial intelligence, the theory and technology have become more and more mature, and the application field has also continued to expand. It is conceivable that the technological products brought by artificial intelligence in the future will be the "container" of human intelligence. This paper discusses the application of artificial intelligence technology in traffic flow management and highway maintenance. The aim is to improve the convenience of commuting through the feasibility of artificial intelligence technology, at the same time, reducing the probability of traffic accidents, give people more a convenient, stable, safe travel environment.

2. A BASIC OVERVIEW OF ARTIFICIAL INTELLIGENCE

2.1. Introduction to Artificial Intelligence

Artificial Intelligence (AI), as an important branch of computer science, was formally proposed by McCarthy at the Dartmouth Society in 1956, and is currently known as one of the three cutting-edge technologies in the world.

Professor Nilson (Nilson), the famous artificial intelligence research center of Stanford University in the United States, defines artificial intelligence as "artificial intelligence is the subject of knowledge - the subject of how to express knowledge and how to obtain and use knowledge. Another famous American university Professor Winston believes that "artificial intelligence is the study of how to make computers do intelligent jobs that only humans could do in the past. In addition, there are many definitions of artificial intelligence, which have not yet been unified, but these statements all reflect the basic ideas and basic content of artificial intelligence. From this, artificial intelligence can be summarized as the study of the laws of human intelligent activities. Construct artificial systems with certain intelligent behavior. The word intelligence comes from Latin and literally means to gather, collect, gather, and choose from. It is generally believed that intelligence refers to the ability of human beings to be manifested by mental work in the activities of understanding the world and transforming the world. That is, the individual's comprehensive ability to reasonably analyze, judge and act purposefully on objective things and effectively deal with the surrounding environment [1].

2.2. Development History of Artificial Intelligence

Since ancient times, human beings have tried to use machines to replace part of the human brain work according to their own level of knowledge and the technical conditions at that time, in order to improve the ability to conquer nature. In 850 AD, there is a legend in ancient Greece that robots were created to help people work. In more than 900 BC in China, there are also records

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of the legend of singing and dancing robots, which shows that the ancients had the illusion of artificial intelligence. As history progressed, by the end of the twelfth century to the beginning of the thirteenth century, the Spanish theologian and logician Romen Luee attempted to create a general-purpose logic machine that could solve a variety of problems. In the seventeenth century, French physicists and mathematicians made the world's first mechanical adder that could calculate and obtained practical applications. Then the German mathematician and analyst G.W. Leibniz developed and made a calculator for all four operations on the basis of this adder. He also put forward the design idea of a logic machine, which is to reason about the characteristics of objects through the symbol system. This idea of "universal symbols" and "inference calculation" is the bud of modern "thinking" machines, so he is praised by later generations. The first founder of mathematical logic. Then, British mathematician and logician Boole initially realized LeibniZ's idea of symbolization and mathematization of thinking, and proposed a brand-new algebraic system, which is Boolean algebra widely used in computers later. At the end of the 19th century, British mathematician and mechanist C. Babbage devoted himself to the research of different engines and analytical engines. Although it could not be fully realized due to the limitation of conditions, his design idea deserved to be the highest achievement of artificial intelligence in that year.

3. APPLICATION OF ARTIFICIAL INTELLIGENCE TECHNOLOGY IN TRAFFIC FLOW MANAGEMENT

3.1. Predicting traffic flow to improve traffic congestion

With the development of China's automobile industry, the problem of congestion on urban roads and expressways is becoming more and more serious. Based on traffic flow data mining and the establishment of a traffic flow prediction model, it can effectively predict traffic congestion and guide vehicles to choose reasonable travel routes [1].

The evolution prediction of traffic congestion and the determination of congestion nodes are of great significance to government congestion and passenger travel. Traditional research often uses mathematical formulas or simulation software to analyze the traffic conditions of the road network. Most of these research methods require certain assumptions and a very complicated model revision process. Traffic volume continues to increase as smart hardware grows [2]. Traffic congestion prediction based on large data volume is derived. In this research method, the congestion state of the road network is abstracted as a high-dimensional matrix which changes with time, and a large amount of data is integrated and sorted by mathematical means to establish an effective mathematical model, at last, we can predict the road traffic condition more accurately by learning the historical trend among the matrix elements.

3.2. Intelligent traffic lights dynamically adjusted according to traffic flow

With the rapid development of computer technology, the detection technology based on machine vision has been applied to the traffic monitoring system, through video detection technology can be real-time detection of vehicles in the intersection of the queue length. The data collected through video detection are arranged and integrated to generate the distribution of the waiting queues at intersections, so that a real-time and dynamic time allocation control scheme is adopted to alleviate the vehicle queuing situation at intersections through dynamic control of traffic lights, to a certain extent, solve the city morning and evening rush hour traffic disease [3]. This scheme is divided into three parts: Video Image Acquisition, digital image processing, traffic lights and signal control. First, real-time images of vehicle queue length are collected by cameras installed in four directions at intersections, and the image data are stored and transmitted; then real-time external processing is carried out by digital signal processor, the queue length is calculated by image preprocessing, image segmentation and setting up virtual box in real time Finally, the vehicle queue length is used as the decision variable of the pedestrian crossing time to allocate the traffic light time in real-time.

Traditional traffic lights waste a lot of green time, for the intersection of two-way traffic flow inconsistent situation is very unfavorable. The above-mentioned scheme can make the best use of the green time, avoid the waste of the green time and increase the waiting time of vehicles, and can effectively alleviate the traffic congestion at the intersection.

4. APPLICATION OF ARTIFICIAL INTELLIGENCE TECHNOLOGY IN HIGHWAY MAINTENANCE

4.1. Detection of roads using pattern recognition and image recognition

(1) Road icing detection technology

In all kinds of traffic accidents, the proportion caused by road slippage and icing is as high as 70%. The traditional method generally relies on human detection, but due to the rapid weather changes and the short validity period of the data, it cannot meet the safety needs of drivers. Therefore, a road icing detection system that can realize real-time monitoring is extremely important. It can provide online, real-time information of road condition for drivers and relevant departments, and reduce accidents [4].

The road icing detection system mainly includes optical fiber sensor, piezoelectric film Sensor, temperature sensor and image sensor and so on, which can detect and report the road condition in cold weather. In the detection system, the optical fiber sensor is mainly used for ice detection in the range of 2-10 mm [5]. And the piezoelectric film sensor is mainly used for ice thickness detection before 0-2 mm[6]. At the same time, we should use the temperature sensor to monitor the temperature in

real time. When the temperature is higher than a critical value, we can judge the ice-free situation, and then shut down the whole system. The image sensor in the system is a high-definition camera with an adjustable set-distance. It can collect real-time images of the road surface and reduce the error rate of the detection system. After sending back the data of each sensor of the road surface detection system, the critical values of different road icing conditions are set, the data are analyzed and classified to establish the model, and finally the concrete road conditions are judged by the combination of pattern recognition technology and real-time data, to improve the accuracy of road icing detection, thus, road icing detection system will be more accurate and timely than the traditional way of data transmission to the driver and related departments, to achieve the greatest possibility of information exchange of road information, the invention ensures the safety of the driver and reduces the occurrence of road accidents.

Road crack detection

With the increase in maintenance work, real-time, fast and efficient non-destructive testing technology of road surface has become the basis of road management and road maintenance operations.

For the detection of pavement cracks, the damage is mainly judged from the width, length and depth of pavement cracks. However, there are not many online detection devices for pavement cracks at present, and no similar mature products have come out in China. At present, most of them are detected by manual visual inspection, which has the advantage of being accurate, but has shortcomings such as low efficiency, requiring more manpower and material resources, and affecting road traffic. If the road surface is photographed with a vehicle-mounted camera, a driving recorder or a drone, machine vision technology is used instead of manual detection of road marking damage, combined with GPS data to achieve accurate damage positioning, and then local maintenance can be performed, which can not only reduce road marking maintenance cost, improve the maintenance efficiency of road markings, and also make up for some defects of manual detection [7]. Therefore, the use of machine vision technology for road crack detection and maintenance has very important significance and broad application prospects.

4.2. Optimal selection of construction time for damaged roads

In the event of an emergency traffic accident or an emergency around the road surface, artificial intelligence technology is used to predict the impact of the road near the construction site in order to give drivers advance notice to avoid the area, the best route for emergency vehicles to reach the scene is very important. The traditional solution is to choose fewer working days for vehicles, control the construction site, limit the traffic density by reducing the width of the traffic lane, and maintain the construction space, although this can avoid the impact of the accident site on traffic, however, there are drawbacks of low efficiency and even increasing the

burden of road traffic congestion [8]. A combination algorithm based on association rule mining and Dynamic Bayesian network is introduced to construct causal tree from congestion when using artificial intelligence technology to make prediction, the probability of their propagation is estimated based on the information of time and space [9]. The frequent sub-structures of these causal trees not only reveal the repeated interaction between space-time congestion, but also reveal the potential bottleneck or defect of the existing traffic network design. Using the new algorithm to automatically choose the construction time of the damaged road, can maximize the reduction of the impact on traffic, to facilitate the travel of citizens.

4.3. System Life prediction based on fault curve

There is an inherent fault curve in traffic equipment, the fault rate is high at the beginning of the equipment's use, stable in the middle of the use, low fault rate, at the end of the equipment's life, the fault rate starts to rise again. Equipment Life prediction in intelligent maintenance is based on fault curve. Firstly, the service life of the equipment is obtained based on the method of high acceleration test. During the working process, the use time of traffic equipment is accumulated, and based on artificial intelligence, the load under different working conditions is normalized, calculated and the weighted working time is formed.

Based on the weighted working time and the high acceleration test, the prediction of the service life of the equipment is obtained.

5. CONCLUSION

The application of artificial intelligence technology in traffic management can help traffic management work in an efficient and orderly manner, and maximize the utilization efficiency of the transportation field. With continuous expansion, artificial intelligence will be used in many fields in the future to improve people's production and living standards and strengthen my country's comprehensive national strength. This research still has the limitation of implementation, and has not considered the construction cost and maintenance cost of intelligent transportation. If we want to solve this problem, we need to carry out experiment and technology upgrade to control the cost, do not blindly put them into mass production.

In the future, artificial intelligence technology will be more widely used in the field of transportation, as long as we have better technology and more reasonable planning.

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