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Application and development of artificial intelligence in environmental health

Tong Wu[1]

[1] Guangzhou experiment high school, Guangzhou, 510055, China

tonywutong0715@163.com

Abstract. In recent years, major industries have been hit hard by the COVID-19 pandemic, and people have become more aware of issues such as environmental health. The development of computer programs, artificial intelligence (AI), has gradually entered the vision of researchers. The product of this technology can help people better manage and improve the current environmental conditions. This paper, through a method of literature review, aims to explain the development history of AI and its application in different fields such as the environment. Through the research, the paper concludes that artificial intelligence can observe in real time for long periods of time without getting tired like humans do. Based on the application of big data analysis and intelligent programs, artificial intelligence can make reasonable plans in a much shorter time than human beings. However, the solution is only based on the operation of the system. In the actual situation, there will be many obstacles. Therefore, it is still necessary for humans to make judgments based on the results of an operation rather than relying entirely on artificial intelligence. Complicated weather conditions can also make the results of the calculation inaccurate. So there will still be a need to evolve computer programs or for artificial intelligence to be able to calibrate the data it is monitoring from the past.

Keywords: artificial intelligence, environmental science, wireless sensor network, water quality analysis.

1. Introduction

At present, the traditional environmental management method in the world is the sampling and testing of a certain part of the land or watershed by special personnel, which means it cannot timely respond to the environment. As a result, researchers can monitor and assist management through artificial intelligence (AI) devices in real-time.

The original concept of artificial intelligence (AI) came from a question posed by Alan Turing in 1950: Can machines think? and that was the beginning of artificial intelligence. John McCarthy first mentioned the concept of artificial intelligence at the Dartmouth conference in 1956, and this is also the first time that the concept of artificial intelligence has been discussed in detail. The first major AI breakthrough came in 1997, when Deep Blue, a supercomputer built by IBM, defeated Pavlov, the world chess champion. One of the most remarkable things about artificial intelligence in recent years is that Google's AlphaGo defeated several world champions of Go and announced the unrivaled algorithms of artificial intelligence. Today, artificial intelligence (AI) has been used to varying degrees in different fields of the environment. The advantage of Artificial Intelligence (AI) is that it can enhance its learning

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base through continuous learning, which allows a long-trained Artificial Intelligence(AI) device to react and make decisions in a short time. At the same time, the programmed operation of artificial intelligence (AI) allows it to adjust its cognition of different environments in a self-iterative way [1]. Therefore, these characteristics of artificial intelligence (AI) make it particularly outstanding in the aspect of continuous monitoring. Compared with traditional methods that rely on manual sampling in the field, artificial intelligence(AI) can do real-time monitoring for a long time. This makes it more informative for researchers. For example, researchers can summarize the change trend of detected substances in the environment based on artificial intelligence data, which enables researchers to adjust research strategies in a timely manner. In terms of pollution treatment, researchers can know the main sources of pollution and take timely measures based on the discharge data of surrounding pollutants [1].

This paper, through a method of literature review, aims to explain the development history of AI and its application in different fields such as the environment. In the beginning, the paper will briefly describe the origin of AI and its development history. Then, it will introduce some of the current environmental problems facing humanity in the world and draw out the application of AI in their field. After that, we will introduce the design and products of existing AI technologies in different areas of the environment. In the end, we will make a summary of the above, and explain the advantages and disadvantages of AI compared with the traditional environmental management mode, as well as suggestions for future development. It hopes that other researchers will know the development level of the current topic in this field, so that more researchers can participate in this topic and also indicate the general development route in the future.

2. Current environmental problems

2.1. Water ecology

The aspect of water management will always be at the center of people's attention. Although water is a resource that can be recycled, the characteristics of geography and climate cause an uneven distribution of water resources, which means some people in the world always face a serious water shortage. Not to mention that in recent years, the development of human industrialization has made water pollution (e.g. pesticides, industrial waste, untreated sewage) more serious. Different organizations around the world have different rules for the amount of different ingredients in water, but most don't differ very much. The main substances or characteristics detected are dissolved oxygen (DO), biological oxygen demand (BOD), chemical oxygen demand(COD), and many other metal substances, respectively. But many countries do not fully meet the standards set by these organizations. Water pollution in India has reached a critical point, with almost all river systems receiving pollution to varying degrees. According to a survey conducted by the National Environmental Engineering Research Institute (NEERI), 70% of India's water is already severely polluted, far exceeding the water content requirements set by various organizations around the world. In the four river regions selected for the survey, all the samples showed that the oxygen requirements in their rivers were well below the standard values. And the levels of various heavy metals, especially iron, have exceeded the standards suitable for human use. According to the study, pollutants from steel and organic chemical industries may be one of the reasons for the high levels of heavy metals in different rivers over the past 20 years. Within 20 years, the organic chemical industry will produce about 60,000 metric tons of waste a year, and the steel industry will produce about 12,000 metric tons of waste water and pollutants a year. In recent years, the government has imposed quarantine measures in response to the COVID-19 pandemic, which has shut down some factories in India. This, in turn, has made water in some of the basins fit for human consumption, but with the resumption of industrial activity in India, the quality of the previously potable water is once again declining [2].

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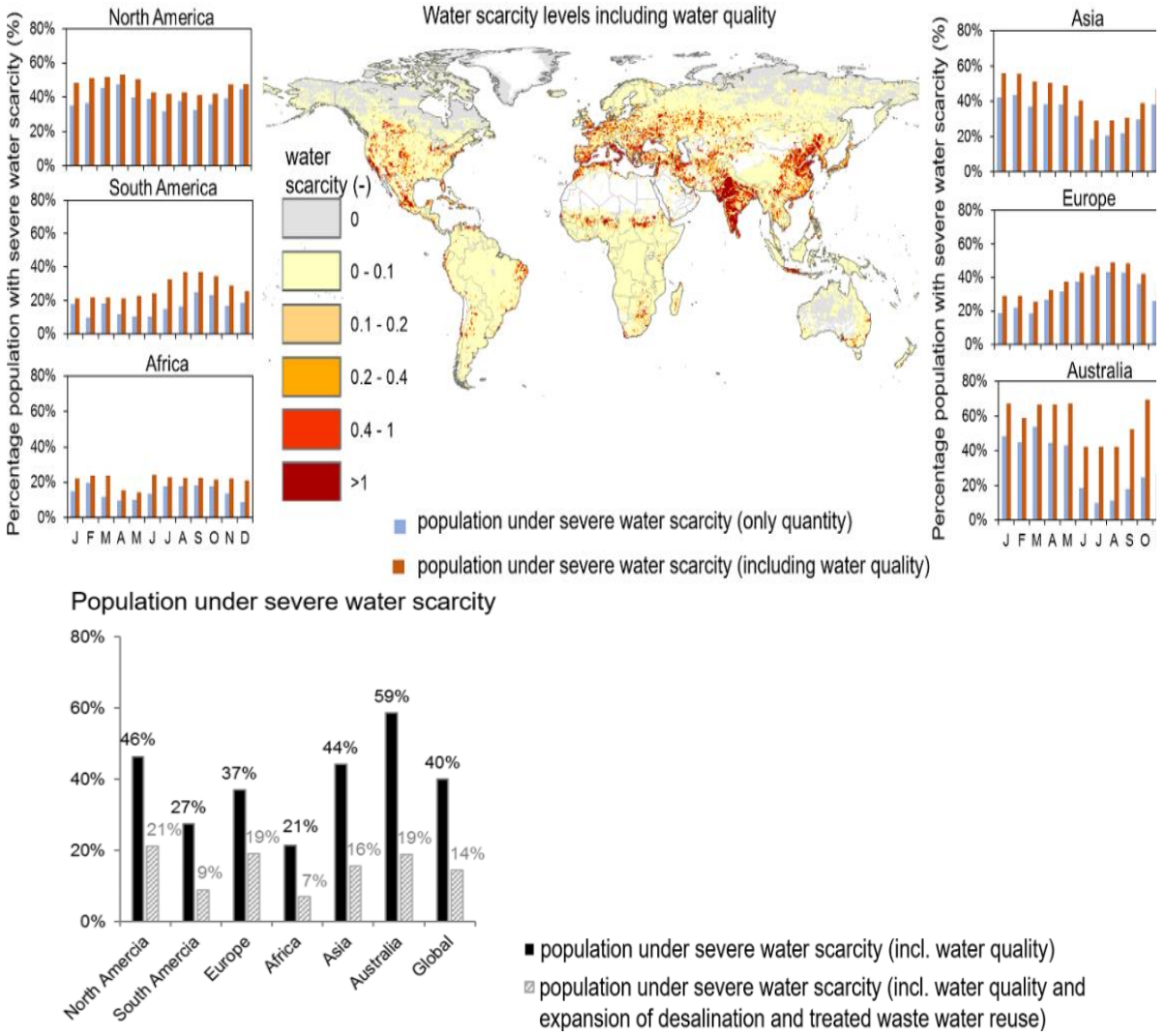

Figure 1.People on different continents are facing water shortages and declining water quality [3].

As a result, pollution caused by industrialization has increased water scarcity from the global average of 30 percent (22-35 monthly average) to 40 percent (31-46 monthly average). As the data shown in Fig.1, it can be found that most countries have different degrees of water shortages, and some even have more than half of the population facing no water shortage situation. Moreover, most countries do not purify wastewater for reuse, which also contributes to the scarcity of water [3].

2.2. Air

Air pollution is another major environmental pollution problem, and air pollution is mainly composed of sulfides (e.g. sulfur dioxide and sulfur trioxide) and small particles (e.g. PM2.5). The formation of most of these pollutants is also related to industrial production and human activities. Some of the sulfide comes from the decomposition of animal carcasses by microorganisms in nature, but this sulfide will be insignificant because of the operation of the surrounding natural environment, so the main sources of sulfide is the unprocessed soot emitted by factories when they burn coal or oil, and the exhaust gas emitted by cars. These exposures also contained particles with a radius of 0.1 to 1 micron, which could easily be moved into people's lungs, causing respiratory illnesses. According to the National Mortality, Morbidity, and Air Pollution Studies (NMMAPS), every 10 micrograms of PM10 increase in ambient air causes a 0.5 percent increase in mortality [4]. The most direct manifestation of air pollution is the

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severe haze phenomenon. Haze refers to the accumulation of large amounts of PM2.5 produced by human activities in the air that cannot be dispersed in time, resulting in the formation of white fog in calm weather conditions. If people live in this kind of weather, it is easy to suffer from various respiratory diseases. At the same time, the haze also greatly reduces the visibility of the scene, which will cause the road traffic to be blocked and greatly increase the probability of car accidents. Since 2015, Beijing, China, has experienced this phenomenon of varying degrees of smog, and the government has taken a lot of measures to deal with this phenomenon. And that is where the value of artificial intelligence(AI) lies.

3. Result and design

3.1. Application of artificial intelligence in water environment

The core point of using artificial intelligence to assist humans in managing and improving water quality is the real-time monitoring of water content. The programming technology is used to build the underlying learning library of artificial intelligence, which basically contains the safe water quality components proposed by the current World Health Organization (WHO), and it is bundled with the perceptron for underwater detection. As a result, the AI can use the learning library of the system to detect the quality, composition, and temperature of the current water, and the composition data will be displayed on the display equipment equipped by the researchers. At the same time, AI can analyze the current environment to develop appropriate improvement plans, and even if the improvement measures are not used properly, the plan can be corrected with real-time data [5]. The technology could also be extended to relatively large watersheds, such as oceans and lakes. Researchers built a platform that consists of a visual navigation unit and is loaded with all the equipment that AI needs [5]. The most important part is a stern-mounted environmental sensing module that can be dropped into the water to measure water temperature, pH, and the various oxygen requirements and heavy metals. A wireless data communication unit can send data to researchers' cell phones or computers so they can learn about the quality of the water. The foam boats are also equipped with propellers, and researchers can remotely control the foam boats to monitor water quality in different areas. These designs greatly facilitate the researcher's follow-up investigation and strategy formulation. The technology has been applied in Hangzhou, China, where field monitoring has been carried out in several mainstream rivers, as shown in figure 2.

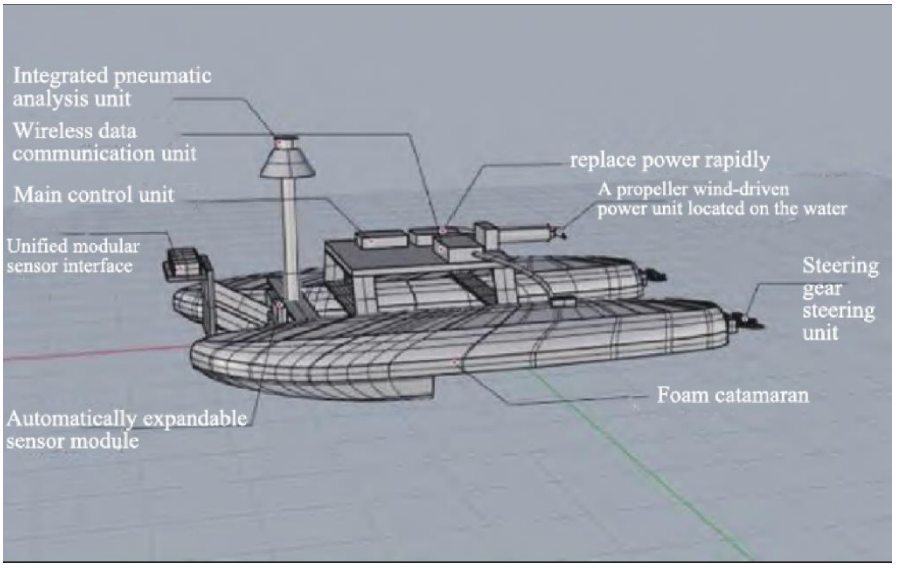

Figure 2 Artificial intelligence water quality monitoring platform [5].

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3.2. The use of artificial intelligence in ambient air

Similar to its application in the water environment, the application of artificial intelligence in the surrounding air is mainly to monitor the content of particles and harmful substances in the air by building an intelligent analysis module. Due to the fluidity of the atmosphere, the data in the air is constantly changing, so a long-term memory network module (LSTM) can be used for prediction training. Using deep learning, artificial intelligence can induce and summarize a large number of past air quality data so as to get the internal relationship between various conditions (such as temperature and humidity). The established prediction neural network will take the air quality data in the past period as the original data, and the data in this period will be cleared and marked with time when a new round of prediction is started. As displayed in figure 3, after enough data was collected, an air quality map containing the whole area was obtained through the Residual Network-50 (RESNET-50) [6]. The operation of such a program can greatly ensure the accuracy of the detected data and avoid the influence caused by man-made or natural factors. The technology has been applied in Tangshan, China. Through the establishment of six air quality monitoring stations in Tangshan, the past seven days of SO_2, O_3,PM2.5, CO and other data collection and analysis were predicted [6]. By using the program of Long Short-term Memory Network Module (LSTM) and Residual Network-50 (RESNET-50), the air quality of Tangshan in the future seven days was predicted. In the early stages of application, the prediction formed by artificial intelligence will be higher than the actual situation, but the predicted change trend is consistent with the change trend of the actual test. After three weeks of data accumulation, the prediction results produced by artificial intelligence are basically consistent with the actual results, and the error generated is less than 11% [7]. But in extremely complex weather conditions, the predicted results can be different from the actual results. The Long Short-Term Memory Network Module (LSTM) can indeed maintain a certain accuracy in such complex weather conditions, but its effect still cannot make the data generated by the prediction results as accurate as in simple weather conditions.

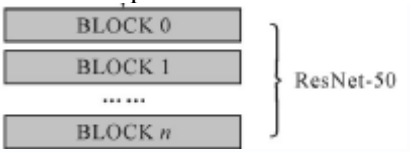

Figure 3 Resnet-50 data processing flow chart [7].

4. Discussion and suggestions

The current artificial intelligence technology can be well applied in different environmental fields. Based on the profound learning base of artificial intelligence itself and the incomparable running speed of human beings, human beings can better and faster develop appropriate improvement or maintenance programs. It is believed that with the improvement of technology, artificial intelligence can handle more and more complex tasks [8]. Of course, although the current artificial intelligence is powerful enough, it inevitably has some defects. Because artificial intelligence operates on the basis of having a strong learning library for environmental issues, it is not easy to build artificial intelligence in the early stages, because you need to invest a lot of data to help artificial intelligence build its learning library, so the early investment is huge. At the same time, at present, some environmental problems, such as air pollution, are changeable due to the complex climate system. Artificial intelligence needs strong computational logic to predict such changeable environments, but this inevitably sacrifices the accuracy of the results [9]. The accuracy of artificial intelligence results can only be quantitatively improved by improving the performance of artificial intelligence (AI) or using a large number of different programs to calculate at the same time. It is believed that with the development of human computer programs and science and technology, artificial intelligence can assume more functions in the future and further improve the accuracy of the detected data.

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5. Conclusion

The application of artificial intelligence in the field of environment is meaningful and allows researchers to no longer, like traditional environmental management, only in a single area for random sampling inspection, but the different environments can be monitored in real-time, allowing researchers to obtain more useful data and also more time for action. However, the ability to be affected by the weather has always been an obstacle for artificial intelligence. Complex weather conditions can easily make the monitoring results lose accuracy. Therefore, it is necessary to specially build a calibration procedure for artificial intelligence. By storing and analyzing past data, artificial intelligence can ensure the accuracy of data in complex environments as much as possible, but there is no program that can meet such accurate calibration.

As for the limitations of this paper, it is only based on the literature of other scholars for comprehensive elaboration and comparison, but does not systematically use the formula model for specific analysis. Moreover, this study only briefly discusses the use of artificial intelligence under incomplete information. There are many assumptions, such as the limited budget of building programs, which can be used as conditions for further research. Thus, this study simply points to what AI has already achieved in the environment and the potential development direction.

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