The following article is an English translation of the original report by Hubei Daily. The English translation of the original report was done by ZWEEC Analytics and should not be attributed to any other party.

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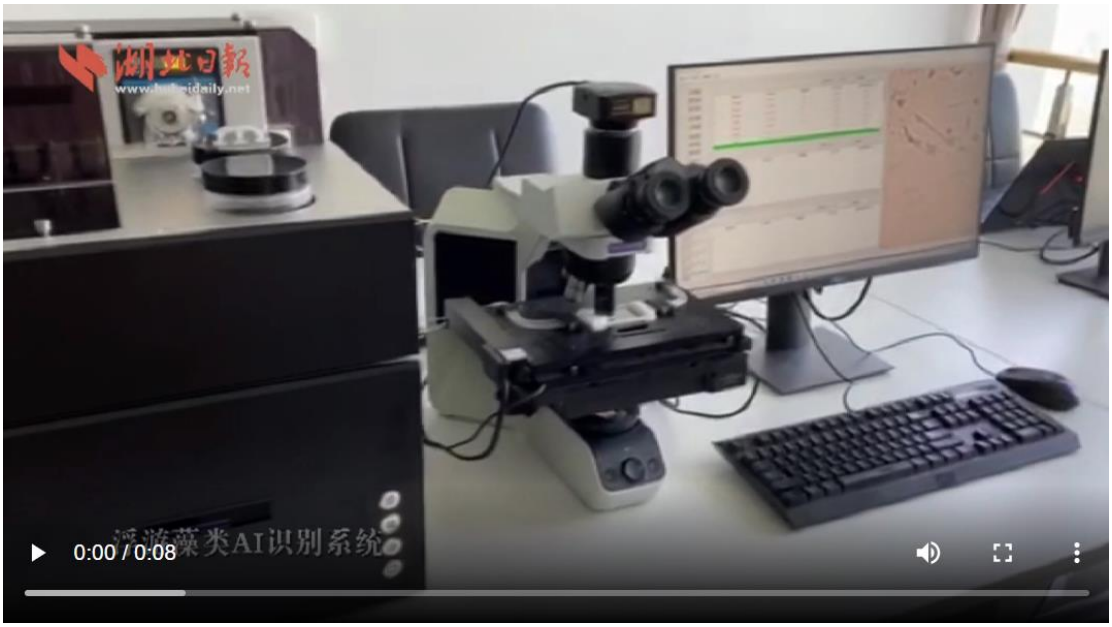
A New Breakthrough has been made in Automatic Monitoring of Water Ecology in China: AI to Diagnose Water's Health



Hubei Daily News (Reporter Hu Xian). Following the automation of water quality monitoring, a new breakthrough has been made in automatic monitoring of water ecology in China. Recently, we learned from Yangtze River Eco-Environmental Supervision Administration and Scientific Research Centre (hereinafter referred to as the Yangtze River Authority), of the Ministry of Ecology and Environment of the People's Republic of China that, after three years of research, the Yangtze River Authority has successfully developed an AI identification system for planktonic algae, which is planned to be applied to the South-to-North Water Diversion Project (Middle Route) this year.

"The current water quality monitoring indicators can indicate pollution, however, whether the water is healthy depends on whether the organisms in it are healthy." According to Mr Wang Ying Cai, chief engineer of the Yangtze River Authority, since the 1990s, water bloom events have occurred frequently in various regions, and water ecology monitoring and algae research have gradually started.

According to reports, planktonic algae belong to primary plants, with different sizes and shapes, and need to be identified by microscopic observation. Although they are

small, they are relatively large in number, very important in water ecosystem and can be a good indicator of water body's health.

According to reports, the current water ecology monitoring in our country is still manual, such as phytoplankton, zooplankton, benthic animals, etc., is all using traditional manual microscopy. For professionally skilled specialists, they need more than 3 years of training and practice to be competent. "It is difficult for undergraduates to take up jobs directly and postgraduates in related majors are extremely limited. As the result, there is a shortages of water biological monitoring talents in our country."

Planktonic Algae AI Identification System

With the maturity of facial recognition technology, a new idea was born: Use AI technology to identify planktonic algae and achieve an automatic monitoring of water ecology, to achieve "curve overtaking" in our country in this area! "There are more than 40,000 species of planktonic algae, with different shapes and complex group composition, which is the most challenging problem in the automatic monitoring of aquatic organisms." Mr Wang Ying Cai believes that once the planktonic algae AI recognition technology breaks through, it means that automatic monitoring of water ecology has gnawed off the "hardest bones".

In 2017, with the support of a major national project (Construction of water quality early warning and operational management platform for the South-to-North Water Diversion Project (Middle Route)), Yangtze River Monitoring and Scientific Research Centre, in cooperation with South-to-North Water Diversion (The Central Route) Engineering Construction Administration Bureau, ZWEEC Environmental Technologies (China) Co., Ltd., and other units, have carried out AI identification research on planktonic algae. Today, the technical team has made significant progress in the automatic sampling technology of planktonic algae, multi-depth microscopy and image processing technology, and AI recognition model research and development. They

have achieved the automatic analysis and output of algae species, proportion, algae density and other indicators under unattended conditions.

According to Mr Liu Haobing, CEO of ZWEEC Environmental Technologies (China) Co., Ltd., the planktonic algae AI identification system has completed the learning and identification of common algae in Danjiangkou Reservoir and the main canal of the South-to-North Water Diversion. The first instrument will be used in the water ecology monitoring of the Middle Route of the South-to-North Water Diversion Project soon. In the future, the planktonic algae AI identification system is expected to be popularized in rivers and lakes across the country to improve the efficiency of algal bloom warning. Its technology can also be extended to the automatic identification of zooplankton, fish, and other aquatic organisms, laying a solid foundation for the water ecology automatic monitoring in our country.

[Extended reading] How to Practise the "Fiery and Golden Eyes" in the Water

January 29, at the Yangtze River Monitoring and Scientific Research Centre laboratory, the planktonic algae AI identification system was analysing water samples from the main canal of the South-to-North Water Diversion Middle Route. The water samples enter automatically, the microscope automatically switches the field of view, takes pictures, identifies algae, the computer automatically recognises and counts, and the data is updated in real time.

At 9 o'clock in the morning, the data results showed that Navicula accounted for 48.79%, Hydrangea accounted for 35.49%, and Trichocystis accounted for 6.19%... "The algae data indicates that the water ecology of the water body is in good condition.", judgment by Mr Wang Ying Cai, chief engineer of the Yangtze River Monitoring and Research Centre.

Facing the various types, sizes, and shapes of planktonic algae, how does an "expert" in the AI identification of planktonic algae develop a pair of "fiery and golden eyes"?

Advanced Algorithm: Much Harder Than Facial Recognition

ZWEEC Environmental Technologies (China) Co., Ltd. focuses on the application of computer vision in the ecological environment. The fish toxicity instrument which has been developed, monitors water quality by observing fish behaviour. In 2014, it has been applied to the South-to-North Water Diversion Project (Middle Route). The company’s CEO, Mr Liu Haobing, introduced that in order to use AI to overcome planktonic algae identification, the technical team jointly established by the company and Yangtze River Monitoring and Scientific Research Centre not only draws on international common algorithms, but also customizes algorithms specifically for algae.

According to Mr Wang Yingcai, human faces are relatively regular, but algae are not. The recognition difficulty is much more difficult than facial recognition, and it is more than several orders of magnitude higher. To this end, the technical team also cooperates with the School of Computer Science of Wuhan University and Singapore's Agency for Science, Technology and Research (A*STAR), and constantly upgrades the algorithm with reference to the latest achievements domestically and overseas.

Equipment Guarantee: Three Major Systems Form the "Body"

The algorithm is like the "brain", determining how smart the planktonic algae AI identification "expert" is. Its "body" consists of three major systems - auto-sample loading device, digital microscopic image auto-scanning system, and intelligent algae identification software.

Auto-sample loading device, can put 15 tubes of samples at a time, carry out an automatic switching of the 15 tubes of samples for sampling detection; Digital microscopic image auto-scanning system, three-dimensional automatic conversion of perspective and focus, automatic completion of shooting; Intelligent algae identification software , and computer self-identification and statistics.

"The algae in a tube of water samples can range from dozens to hundreds of species. Manual microscopy is time-consuming and laborious, especially very tiring to the eye." Mr Wang Ying Cai said, AI would not be fatigued and does not require rest. "The best candidate".

Samples Accumulation: Repeated Learning of "Textbooks"

Navicula, the shape is symmetrical from top to bottom; the genus Hypophyllum is symmetrical from top to bottom, asymmetric from left to right, curved like a bridge; Microcystis is highly resistant to pollution, suggesting that the water body is polluted... Mr Wang Ying Cai opens the algae catalogue.

With such a thick catalogue, traditional manual monitoring requires professionals to learn and practice for more than 3 years before they can master it. AI is faster and more accurate. Just like meeting a person for several times, AI identification of algae requires repeated learning. The "textbook" to be learned is a calibrated sample library. The sample library is identified by experts. Mr Liu Haobing said that for each species of algae, 500 to 1,000 pictures of different angles and sizes are needed for the machine to identify clearly.

Most of the algae are less than one-tenth the diameter of a human hair, which is not only difficult to photograph, but also easily disturbed by other factor such as sediment.

“We have taken a total of millions of photos of algae, selected hundreds of thousands of them, and then synthesized tens of thousands of them to use as ‘textbook’ to allow the machine to learn deeply and iteratively." Mr Liu Haobing introduced. Currently, AI algae "experts" have been able to identify common algae in Danjiangkou Reservoir and the main canal of the South-to-North Water Diversion Project, and the accuracy rate meets the requirements of routine monitoring.

"This is a well-informed process. If you are familiar with a person, you can recognize him just by hearing his footsteps. That is the same as machine." Mr Wang Ying Cai said, “As long as the learning is repeated, AI can identify more algae, and the accuracy rate will be higher.”

Currently, the algorithm of the planktonic algae AI identification system is basically mature, and the sample library is still expanding, and it will be optimized and upgraded in the later period. Mr Wang Ying Cai introduced that the equipment will soon be used

in the water ecology monitoring of the South-to-North Water Diversion Project (Middle Route) and is expected to be applied to different water bodies in our country to accelerate the process of water ecology automatic monitoring.

(Hu Xian, Hubei Daily Media Reporter)

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