**Artificial intelligence-based morphological identification and analysis of testate amoebae**

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With the increasing need for faster and more accurate identification of microorganisms in various fields, including environmental sciences and ecology, artificial intelligence (AI)-based methods are becoming an attractive alternative to traditional manual identification. However, this method has not yet been applied to testate amoebae, which are critical in environmental reconstruction and bioindication. This study aims to explore the potential of an AI-based approach in the morphological identification and analysis of testate amoebae. We conducted sampling in June 2022 and collected 219 testate amoeba micrographs from 30 water and 30 surface sediment samples from three adjacent ponds of Yanziling Park in Shenzhen, China, for morphological analysis. We propose an AI model that uses pixelated microscopic images of samples to detect and classify testate amoebae based on their morphological characteristics, such as shell length, width, and depth, aperture diameter, shell surface texture, and color. We demonstrate the effectiveness of our model by comparing its performance to that of traditional methods such as microscopy using a dataset of testate amoebae with known identities. Our results show that our AI-based approach achieves high accuracy and speed in identifying and analyzing testate amoebae, making it a promising tool for future research in testate amoeba biology and ecology. The potential applications of this technology range from the rapid diagnosis of the morphology of bigger and smaller testate amoebae to the analysis of a large quantity of environmental samples for new species discovery.

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