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Development of an Integrated Open Space Monitoring Platform for Mangrove Habitat Information

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Abstract:In order to strengthen the protection and restoration of mangroves, this paper developed an integrated mangrove habitat information monitoring platform. Platform combined with ECharts visualization technology, YOLOv8 target identification technology and hyperspectral technology, that implements the mangrove growth information, soil information, water quality information, species information and disease information visualization. At the same time, it provide administrators to do equipment management, abnormal management, user management, data analysis, and to diversify management. The platform provides possible for comprehensive monitoring and display of Zhanjiang mangrove growth status.

Keywords: mangrove; YOLOv8; ECharts; habitat information; monitoring platform

1. INTRODUCTION

Mangroves are salt-tolerant woody plant communities endemic to the intertidal zone of tropical and subtropical coastal areas. It can not only provide habitat for a variety of organisms, but also prevent wind and waves, protect seawalls and purify the environment. Zhanjiang city of Guangdong Province is located in the southernmost part of mainland China, with a coastline of 2043.6 kilometers. The mangrove nature reserve covers an area of 20278.8 hectares, among which, the mangrove area is more than 9000 hectares, accounting for 33% of the national area and 78% of Guangdong Province. It is the largest mangrove area and the most concentrated area in China[1]。

However, due to the high damage rate, low technology of monitoring and strong environmental pollution. This research is based on the current mangrove, the new era policy background and research pain points, Taking the largest and diverse mangrove nature reserve in China — Zhanjiang Mangrove National Nature Reserve as the pilot experimental area, Developed a visual management system for mangrove habitat information monitoring, Aims to strengthen the monitoring and protection of mangroves with a technical orientation, Improve the work efficiency of the mangrove management departments, Enhance public awareness and awareness of mangrove conservation, Enabling the construction of the "Mangrove City" in Zhanjiang, We will help promote the continuous development of key national ecological projects such as the "Blue Bay" and "ecological islands and reefs".

2. DEVELOPMENT STATUS, BOTH AT HOME AND ABROAD

At present, the protection and management of mangroves have become the hot spot of The Times, with rich research results on mangrove monitoring technology, content indicators and system development at home and abroad. In terms of monitoring technology and content indicators, the current research mainly relies on advanced remote sensing technology and ground observation methods. In the application of remote sensing technology, researchers can obtain various spectral information including visible light, multispectrum and high spectrum through different sensors[2]. In addition, remote sensing technology is widely used in the research fields of mangrove spatial distribution mapping, the classification and identification of animal and plant species[3]. The monitoring of water and water growth status involves the sample site survey method, the pollutant index monitoring of water and sediment, and the data collection of soil quality[4]. In terms of system development, the development and research of mangrove monitoring system at home and abroad lag behind. Current studies often rely on off-the-shelf desktop software, such as the remote sensing image processing software ENVI[5], Or the secondary development of customized desktop applications based on GIS tools such as ArcEngine[6].

Based on the research results at home and abroad, the mangrove and habitat information visualization management system needs to solve the following three aspects: first, the system needs to integrate remote sensing GIS, UAV data collection, ground sensors and other methods to conduct more comprehensive data collection, data processing, data visualization and data management, and the system indicators should be comprehensive and multidimensional visualization, including soil data, water quality data, airborne hyperspectral growth data, pest identification, species identification and mangrove science popularization. Third, mobile terminal data visualization, to facilitate the promotion and the application. Therefore, this system will comprehensively solve the above three aspects, to develop a more integrated technology, more comprehensive indicators, and promote a more convenient mangrove habitat information visualization management system.

3. SYSTEM REQUIREMENTS ANALYSIS

3.1 Use Case Requirements analysis

Users can access the system by registering and logging in to their personal accounts, tourist accounts and other ways, and have a variety of data visualization operations. Users can monitor the visual data in real time, view the real-time data of water and geology, understand the growth status and distribution of mangroves, and also see the real-time weather changes and hot word clouds. In addition, users can also learn about the mangrove public welfare publicity board and also manage personal information. The administrator's authority not only covers all the functions of ordinary users, but also adds unique management functions. The administrator can also modify and adjust the equipment information, member

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audit, growth abnormality, image cache, publicity data and other contents.

3.2 Functional requirements analysis

This project is divided into client end and administrator end. In the client-side function module, the real-time monitoring module will provide a dynamic data flow to show the key indicators in the mangrove ecosystem, such as the basic information such as water quality, soil conditions and meteorological changes. The water field data module records and displays real-time data on water quality and geology closely related to mangrove health. The species identification visualization module can use the image recognition technology to help the user to identify the plant species within the region. The growth distribution visualization module will show the growth trend and spatial distribution of mangroves. Hot word cloud visualization module can help users quickly find the hot topics and concepts related to the research content through big data computing analysis. The satellite map observation module will use GIS GIS technology to provide users with the ability to observe the mangrove ecology from a macro perspective. The public welfare publicity module aims to enhance the public's awareness of the importance of mangrove conservation through articles, videos and other forms, and to display conservation results and cases. The personal information management module can provide users with the function of modifying the information, and build a platform for personalized display for users. The functional requirement analysis map is shown in Figure 1.

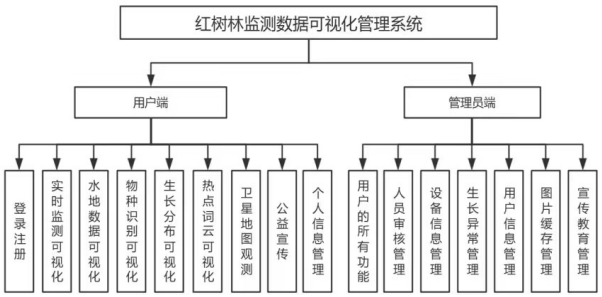

Figure. 1 Functional requirements analysis diagram

4. SYSTEM DESIGN

4.1 Technical architecture design

This system adopts the design mode of front and rear end separation. The front end uses Vue. The js framework, using its responsive and componentized features, builds the user interface. Complex data visualization is achieved by integrating the ECharts chart library, while providing consistent UI styles and rich interactive components using the Element-UI library. On the back end, the RESTful API is quickly built based on the Spring Boot framework to simplify the development process with its powerful ecological and automatic configuration features. Combined with the MyBatis-Plus ORM framework enables efficient operation of MySQL databases while exploiting its dynamic SQL capabilities to handle complex queries. The system deployments use Nginx as a reverse proxy server for load balancing and high availability. Distributes hardware data requests to back-end services deployed on the ECS cloud server.

4.2 ER design

Design the database according to the functional requirements analysis. The user table records user information such as user name, password, and email address. Users can view the field information in the water quality data table, growth information table, public welfare publicity table, geological data table and equipment information table. The administrator table records the administrator and is responsible for managing the rendering data generated by each module to ensure the practicality of the system.

5. System implementation

5.1 Main interface display

The visualization of the monitoring data is one of the core functions of this system. In the real-time monitoring visualization screen interface, the working state of the UAV and high-definition camera is displayed, the upper left shows the real-time water quality and geological monitoring data, the upper right shows the real-time weather state on the right, and the image in the lower right corner. The main interface of real-time monitoring is shown in Figure 2.

Figure. 2 Main interface of real-time monitoring

In the visualization interface of water quality parameter data, various charts such as ring chart, line chart and bar chart are used to show the water quality parameters such as water turbidity, pH value, temperature and oxygen content, providing credible data reference for the protection of mangrove growth environment. The visualization interface of water quality data is shown in Figure 3.

Figure. 3 Visual interface of water quality data

In the species identification module, users can upload the photos taken by the UAV to the system. The system uses YOLO v7 algorithm for target identification. Through a large number of data set training, the system can effectively identify alien invasive species, such as Spartflora, fish and vine grass, etc., to provide practical reference for the protection of mangrove species and improve the intelligence level of the system. In the data analysis module, the system uses Svector machine learning algorithm to predict mangrove growth indicators such as pH, metal content and water turbidity. At the same time, the system supports the data warning function to warn the real-time monitoring of abnormal data. Data early warning and data prediction functions can provide visual reference for mangrove protection.

5.2 Key algorithm design

1. The species identification algorithm

The key function of the species identification technology is to perform the target detection of the input images. To this end, this project has designed a function called run_image, which loads the self-trained model weight file best. And pt, scale the input image, normalize it, reason with the model to get the predicted results, and process the predicted results. Finally, write the processed file to the out. The jpg picture file and print the corresponding information.

2. AMQP algorithm to obtain Ali Cloud data

AMQP, the advanced message queue protocol, is a widely used communication protocol in the Internet of Things. In this project, the hardware side will upload the test data to the Ali Cloud IOT cloud platform for hosting, and the software side will write the AmqpService class to process the messaging tasks related to the AMQP protocol, so as to obtain the hardware collection data on the Ali Cloud server. The AmqpService class converts the JSON format content parameters transmitted by Ali Cloud into Map objects to facilitate subsequent programming operations. The class traverses the Map object in a key value pair, and finally adds the Date object to a list named list, and sets the list to the list property of the Content object for subsequent processing, storage, and transfer.

6. CONCLUSIONS

Based on the YOLOv8, screen visualization, unmanned aerial vehicles remote sensing and remote sensing technology, project developed a beautiful interface, comprehensive data, intelligent analysis of mangrove habitat information monitoring data visualization management system, greatly satisfy the mangrove growth real-time monitoring, species identification, data prediction and early warning business requirements, can help Zhanjiang mangrove ecological protection and restoration go deep, promote green beauty Guangdong ecological construction.

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