Research on monitoring technology of marine oil spill environment based on LoT+GIS

Zhiqiang Zhao

Binzhou Vocational College, Binzhou, Shandong, China

Keywords: LOT; GIS; oil spill; environmental monitoring

Abstract: This paper designs a real-time construction system for marine oil spill pollution scenarios based on I0T+GIS, including a processing mechanism for receiving and processing marine oil spill pollution data, a simulation mechanism for simulating and constructing real-time scenes, and a receiving and processing mechanism. The letter totals three components of the control mechanism that controls the simulation mechanism. The real-time construction system of the marine oil spill pollution scene based on IOT+GIS of the present invention combines the three components of the processing mechanism, the simulation mechanism and the control mechanism, and uses the IOT and GIS technology to truly simulate the marine oil spill situation in the real scene in the virtual and In the real scene, the real-time and dynamic prediction of sudden marine oil spill accidents is greatly improved, and the efficiency of emergency decision-making for marine oil spill accidents is improved.

The ever-occurring marine oil spill accidents are more and more harmful to the marine ecological environment. How to effectively reduce the damage of marine oil spills to the marine ecological environment has become an urgent problem to be solved[1]. How to carry out reasonable and scientific numerical simulation and analysis of relevant information and reference data, realize real-time and dynamic prediction of sudden marine oil spill accidents, and how to improve the efficiency of marine oil spill emergency decision-making is an urgent need of today's society. There is currently no virtual-plus-reality construction system on the market that can simulate ocean oil spills in real time.

1. System Design

The technical solution adopted in this paper to solve its technical problems is: a real-time construction system for marine oil spill pollution scenarios based on IOT+GIS, including a processing mechanism for receiving and processing marine oil spill pollution data, and a system for simulating and constructing real-time scenarios[2]. The simulation mechanism and the control mechanism for receiving and processing the information of the mechanism to control the simulation mechanism are three components;

The processing mechanism includes computer hardware with network connection function and computer software for analyzing and collecting data:

The computer software includes a GIS system, an IOT system and a control system for issuing control instructions to the control agency for collecting, storing, managing, calculating, analyzing, displaying and describing the relevant geographical distribution data in the polluted ocean surface (figure 1). The simulation mechanism includes a storage device and a transmission device: the storage device includes a glass cylinder for containing simulated seawater, and a first box body and a second box body are fixedly connected to the front and lower ends of the glass cylinder body[3] .The control mechanism includes an information command transmission line for connecting the output end of the processing mechanism and the control input end of the simulation mechanism, and connection terminals located at both ends of the information command transmission line.

DOI: 10.25236/iceieis.2022.031

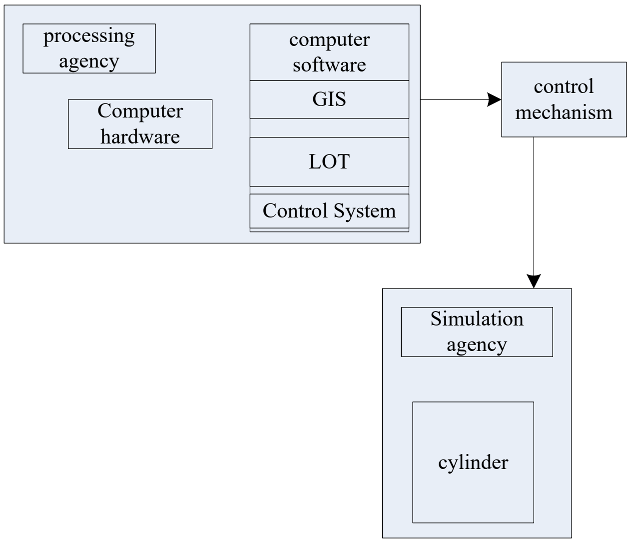

Figure 1 System Architecture Design

2. Realization of the core functions of the system

2.1 Monitoring grid drawing and clipping

From the spatial information of GIS, there are two kinds of grid division: regular grid division and irregular grid division. The regular grid division is mainly based on the grid division of the entire earth surface as the research background, so as to effectively describe the spatial position relationship of the earth surface and solve the problems of GIS spatial positioning and spatial retrieval mechanism. Irregular grid division is mainly for the division of administrative units at all levels to meet management needs[4].

The division of regular grids can be based on a geographic grid divided by polyhedrons, or a geographic grid divided by geographic coordinates. The former uses the inscribed regular polyhedron of a sphere as the basis for division, while the latter is divided by latitude and longitude. The vector representation of regular grid in GIS is a geographic grid divided by latitude and longitude. Set the start point and end point of the generated grid according to the scope of the study area, the system will automatically generate the grid layer of the area according to the set grid size, and then use the land boundary to cut the grid layer to obtain only the grid that covers the study sea area. layer. Combined with the different types of sensitive area layers introduced into the system, each grid is assigned a value by using the set calculation sensitivity method; finally, the thematic map is generated by using the sensitivity value of the grid and the ESI standard. The system can also rasterize the grid layer of the vector to obtain the grid layer of the sensitive area, which can provide different data types for subsequent analysis.

2.2 Oil spill remote sensing processing and information extraction

The operational process of remote sensing oil spill monitoring involves functions such as grid vectorization, thematic product production, and oil spill probability statistics. These functions are the main aspects involved in GIS. The powerful spatial analysis module of GIS can provide strong technical support for oil spill monitoring. ArcGIS Engine is the current mainstream component GIS, this paper uses ArcGIS Engine as the GIS integration environment. Use the ArcEngine secondary development package to integrate the GIS mapping and spatial analysis modules (Figure 2). This study is in. NET development platform, using C support language to realize the oil spill remote sensing monitoring system. The GDAL open source class library used in this paper has better support for the C++ language and is more compatible, but the component GIS used in this paper is based on the Cj6} environment, and the C support is not compatible with GDAL, so this paper uses the C++ environment to process GDAL remote sensing images. The algorithm is encapsulated into a DLL, and then invoked under the C support platform[5].

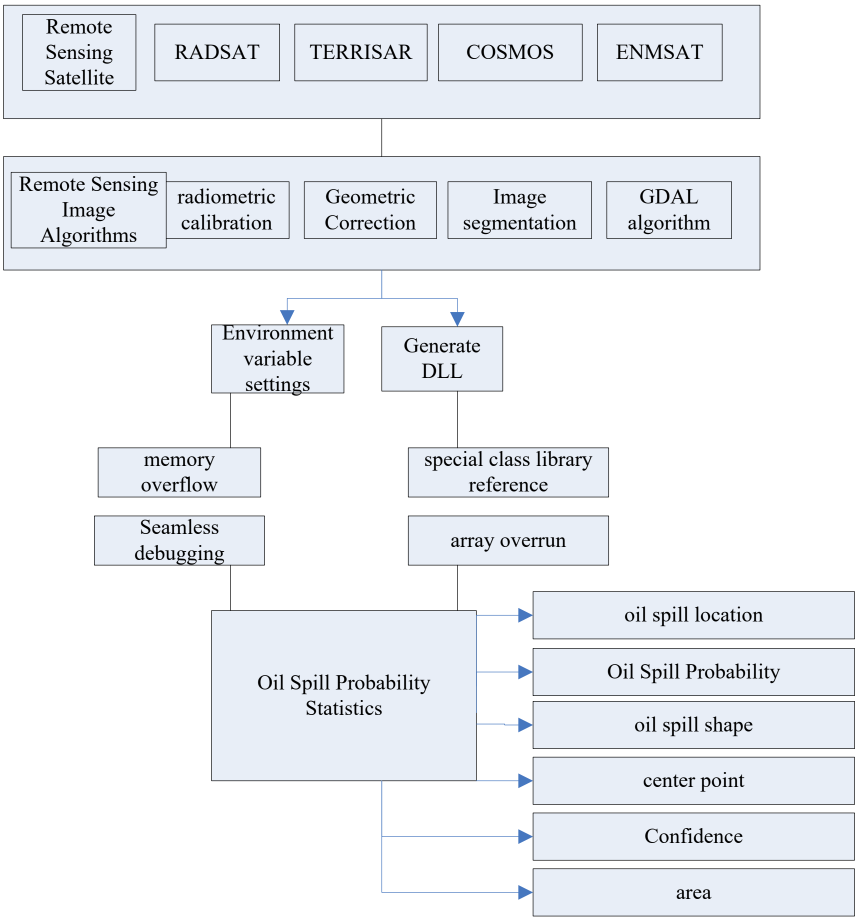

Figure 2 Process of extracting marine oil spill information

3. Extraction and processing of oil spill map spot information in GIS environment

3.1 Oil spill map information extraction

The oil film information extracted from the remote sensing monitoring data is raster data, which cannot be directly screened interactively in the GIS environment. However, GIS supports the vector data patch selection function, and the user can manually select vector data of any range and shape on the vector data. Therefore, this paper uses the IConversionOp in the secondary development of ArcEngine to connect 151 for raster vector processing. The RasterDataToPolygonFeatureData method converts it into vector data that can be interactively processed, and sets it to be transparent when displayed. GIS vector selection function, interactively click the location of the oil spill area, and automatically select the vector data, thereby simulating the raster patch selection function.

3.2 Oil spill map information processing

The edges of the oil spill map should be smooth linear elements, but as a result of the processing, the edges of the oil spill map are obviously jagged, showing irregular edges and corners. In addition, there are too many vector elements in the result of the oil spill map. The GIS spatial analysis function is based on vector elements[6]. Too many vector elements will cause the GIS spatial module to process too slowly and affect the efficiency of use. Therefore, the map must be further processed. This paper proposes an oil spill map processing algorithm based on GIS polygon processing module, and solves a series of problems that do not conform to the actual situation of oil spill map. Firstly, the oil spill area is expanded, and the expansion coefficient is set to 50m according to the empirical value, which can ensure the maximum restoration of the image patch. The scattered patches are aggregated and the boundaries are smoothed. , reducing aliasing. And the processed oil spill pattern is in good agreement with the original oil spill pattern, and the error is within the allowable range. In order to solve the problem of too many feature points in the oil spill map, this paper uses the GIS analysis module to aggregate the feature points, calls the feature merge GP, and merges the elements of the aggregated results, thus solving the problem of too many vector features.

4. Oil spill probability statistics based on LOT and GIS

4.1 Obtaining attribute information of oil spill area

In this paper, the information data of the oil spill area is stored in the oil spill vector data table. In order to calculate the distance between the marine oil spill patch and each influencing element, it is necessary to calculate the position of the center point of the oil spill area and determine the closest point of the target element.

For waterways and drilling platforms, the center point is taken as the calculation object. The port usually has a large space and occupies a section of land coastline. Since the coastline is a linear element with variable shapes, it is not easy to calculate the distance from the center point of the oil spill patch to the coastline. closest distance. This paper uses the calculation of the shortest distance between points and points instead of calculating the distance between points and lines. The line elements are converted into point elements by means of GIS, and the distance between the center point of the oil spill area and the linear point set is traversed step by step through the bubbling method to find the nearest point[7].

According to the suspected oil spill area extracted by the user, based on the positional relationship between the suspected oil spill area and the surrounding environmental variables, this paper designs an oil spill probability statistical algorithm to count the probability of the suspected oil spill area. According to the distance between the oil spill area and the environmental variables, the influence coefficient is set. The farther the distance is, the smaller the influence coefficient is; the closer the distance is, the larger the influence coefficient is. Set different influence weights at the same time according to different environment variables. The influence coefficient and influence weight system will specify a predetermined value by default, and users can manually modify it according to their needs. Then the system invokes the probability statistics algorithm to calculate the oil spill probability statistics, and displays the statistics in a summary and saves them in the attribute table.

4.2 Sensitivity calculation of oil spill area

After drawing the grid surface, it is necessary to calculate the sensitivity value of the grid surface. The main principle of grid sensitivity calculation is the grid space index. The basic idea is to divide the research area into roughly equal or unequal grids with horizontal and vertical lines. , record the spatial entities contained in each grid. When the user performs a spatial query, the grid where the user query object is located is first calculated, and then the selected spatial entity is quickly queried in the grid, which greatly speeds up the query speed of the spatial object. Through the overlapping analysis of each layer, the attribute value of the sensitive area layer in each grid, that is, the size of the sensitive value, is obtained. Various layers include four levels: national, provincial, municipal, and county.

In a grid, multiple levels may exist at the same time. For example, the data of the national layer and the provincial layer are adjacent to each other, and the adjacent parts happen to appear in the same grid, so there are two types of grids. Level layer data; a grid may also have sensitive areas of the same level but different types. In this case, the maximum area method, weighted average method, and arithmetic average method can be used to calculate the grid according to the focus of the study. sensitivity value. By superimposing the grid with different protected area layers, the sensitivity value in the grid is obtained, and visual rendering is performed according to the size of the grid sensitivity, which intuitively displays the distribution of offshore sensitive areas and the sensitivity to oil spill risks.

5. Conclusion

In a word, the real-time construction system of marine oil spill pollution scene based on LOT+GIS is designed in this paper. Through the combination of three components: processing mechanism, simulation mechanism and control mechanism, the marine oil spill situation in the real scene is simulated by IOT and GIS technology. In virtual and real scenes, the real-time and dynamic prediction of sudden marine oil spill accidents can be greatly improved, and the efficiency of emergency decision-making in marine oil spill accidents can be improved.

References

[1] An W , Liu L , Wang Y , et al. Research on Integration Technology of Stereoscopic Environment Monitoring System Based on UAV[C]// International Conference on Aerospace System Science and Engineering. Springer, Singapore, 2021.

[2] Chen W , Hao X , Lu J R , et al. Research and Design of Distributed IoT Water Environment Monitoring System Based on LoRa[J]. Hindawi Limited, 2021.

[3] Jing W . Research on Remote Monitoring Technology of Indoor Environment Based on Computer Technology[J]. Computer Measurement & Control, 2017.

[4] Chen Y , Ma Q , Liu C , et al. Research on marine environment monitoring based on Internet of things[J]. Desalination Publications, 2021.

[5] Zhang Y , Ma Y , Li Z , et al. Research on online monitoring and early warning technology of tripping and closing circuit of intelligent substation[J]. IOP Publishing Ltd, 2022.

[6] Pan X , Computer D O . Research on IOT equipment environmental monitoring technology based on neural network[J]. Modern Electronics Technique, 2017.

[7] Jin X U , Bo L I , Cui C , et al. Research on marine radar oil spill monitoring technology[J]. Marine Environmental Science, 2018.